THE INSTITUTION OF PRODUCTION ENGINEERS JOURNAL

THE INSTITUTION OF

PRODUCTION ENGINEERS JOURNAL

36 PORTMAN SQUARE . LONDON . W1 Telephone: WELbeck 6813/7

Vol. 32, No. 5 *Price 10/-* *May 1953*

CONTENTS

AN EXPANSIONIST POLICY FOR PRODUCTION, by Mr. Lincoln Gordon . . 209

FUTURE PROSPECTS OF THE PRODUCTION ENGINEER, by Walter C. Puckey, M.I.Prod.E., F.I.I.A. 212

THE EXTRUSION OF BRASS ROD AND SECTION, by D. J. Broadley, A.M.T.C. 223

NYLON AS AN ENGINEERING MATERIAL, by E. M. Elliott, A.M.I.Prod.E. . 237

COMMUNICATIONS 243

INSTITUTION NOTES 245

NEWS OF MEMBERS 248

NEW APPOINTMENTS 248

HAZLETON MEMORIAL LIBRARY 249

The Institution of Production Engineers does not accept responsibility for any statements made or opinions expressed in any papers published in the Journal of the Institution.

EDITORIAL COMMITTEE

M. Seaman—Chairman
Sir Cecil Weir, K.C.M.G., K.B.E.—President of the Institution
H. Burke—Chairman of Council
G. R. Pryor—Vice-Chairman of Council
L. Bunn
A. A. Francis
R. Hutcheson
H. P. Jost
W. Puckey
W. J. Dimmock
K. J. Hume
H. G. Shakeshaft
W. J. Webb
F. W. Cooper
R. L. Paice

EDITOR

M. S. C. Bremner

SECRETARY OF THE INSTITUTION

W. F. S. Woodford

PRESENTING THE CINCINNATI RANGE OF BRITISH BUILT MACHINE TOOLS

TOOLROOM AND GENERAL PURPOSE MILLING MACHINES

DIE-SINKING MACHINES

PRODUCTION MILLING MACHINES

SURFACE BROACHING MACHINES

CENTRELESS GRINDING MACHINES

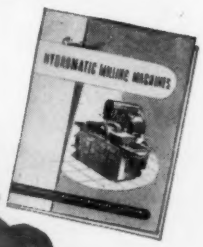
TOOL & CUTTER GRINDING MACHINES

CINCINNATI

CINCINNATI MILLING MACHINES LIMITED BIRMINGHAM 24

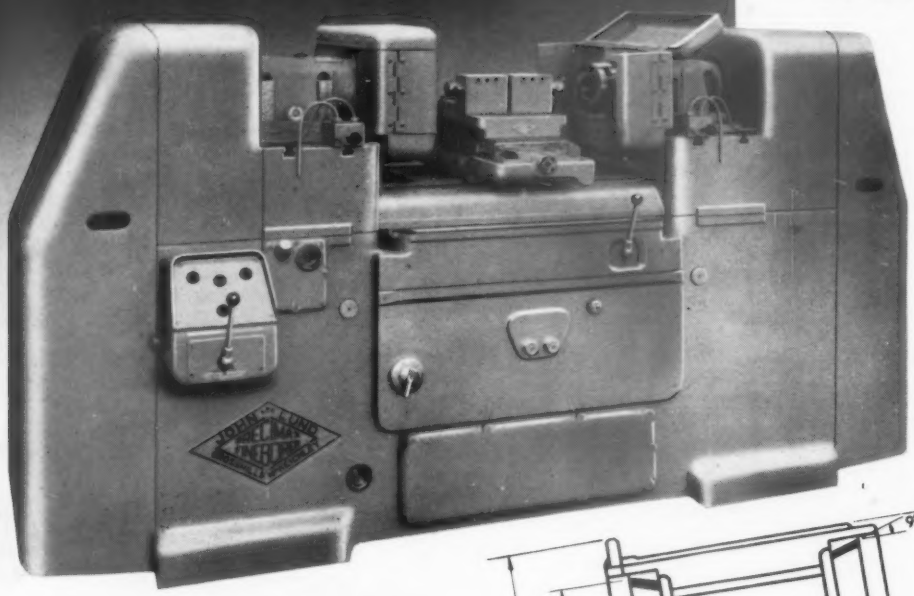
PRODUCTION GOES UP WHEN THE HYDROMATIC GETS DOWN TO IT!

- PLAIN and DUPLEX Standard Styles.
- 36″ to 90″ Table Travel.
- 7½ to 30 H.P. Motors.
- Fully Automatic Table Cycles.
- Raised and widened Headstocks for extra large work.
- Additional spindles can be located horizontally or vertically.

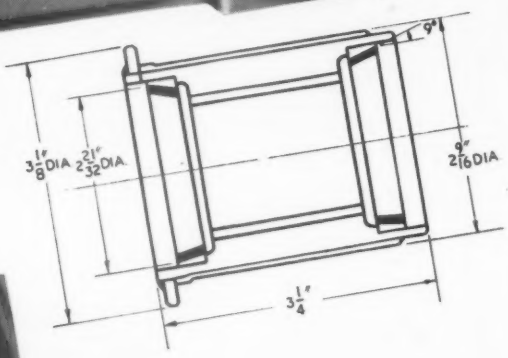


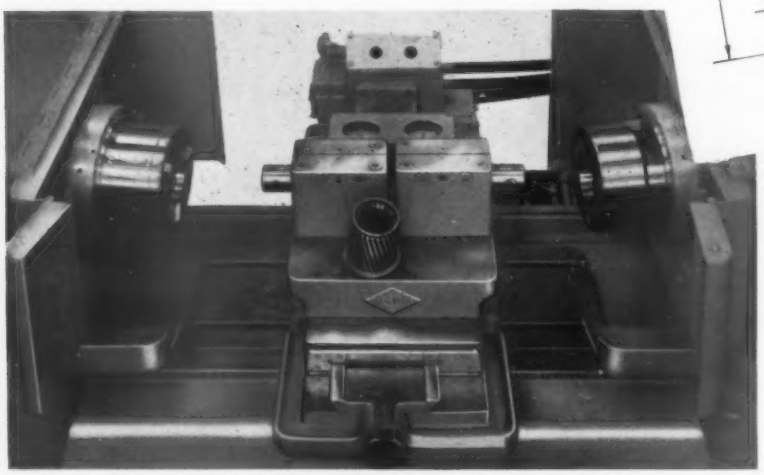
Fully detailed in Bulletin M.1670-E (For production of smaller components, see Bulletin of 1-18 Automatic, M.1555-E.)

FINE - *Taper* - BORING THE "PRECIMAX" WAY



This is how **Vauxhall** Motors Ltd. of Luton, finish the taper recess at each end of a synchromesh gear-sleeve. A sleeve is recessed whilst one, at the opposite end, is loaded in the head. The cutting time (each end) is 12 secs. and the floor-to-floor time—1 min. 51 secs.





By adoption of "Precimax" methods, many automobile and other manufacturers are saving scores of hours in fine boring and in cylindrical and surface grinding work.

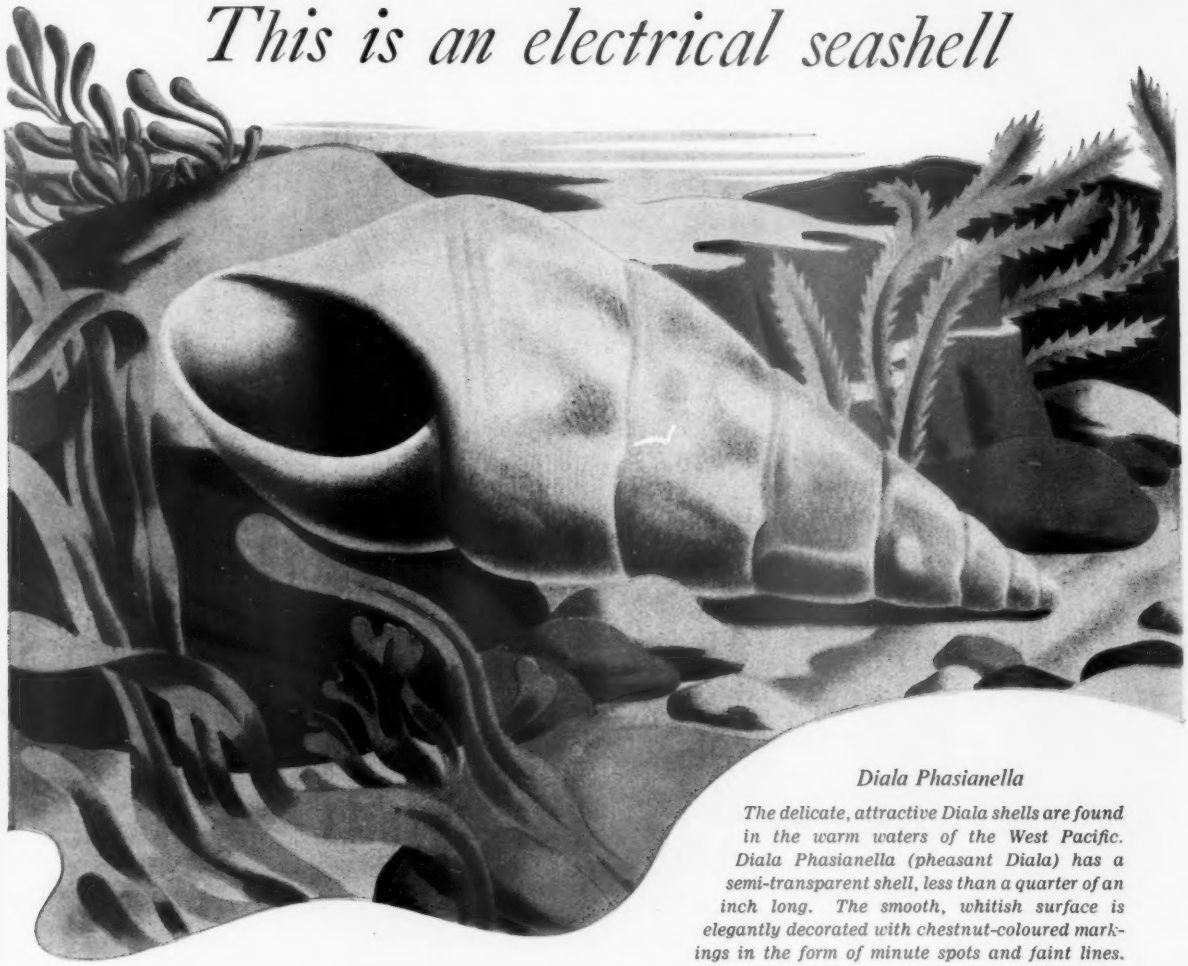
Could you not do so too?
Perhaps we could show you

Write to us about it

JOHN LUND LTD.

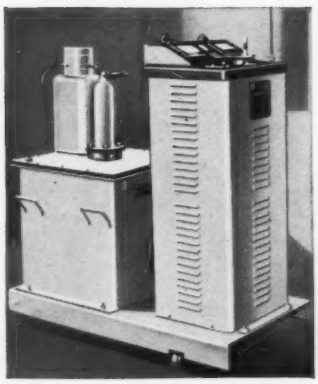
CROSS HILLS Nr. KEIGHLEY

This is an electrical seashell



Diala Phasianella

The delicate, attractive Diala shells are found in the warm waters of the West Pacific. Diala Phasianella (pheasant Diala) has a semi-transparent shell, less than a quarter of an inch long. The smooth, whitish surface is elegantly decorated with chestnut-coloured markings in the form of minute spots and faint lines.



Seashell Oils are produced as the result of world-wide *research. This picture shows apparatus for determining breakdown voltage—one of the various tests carried out on electrical insulating oils prior to despatch.*

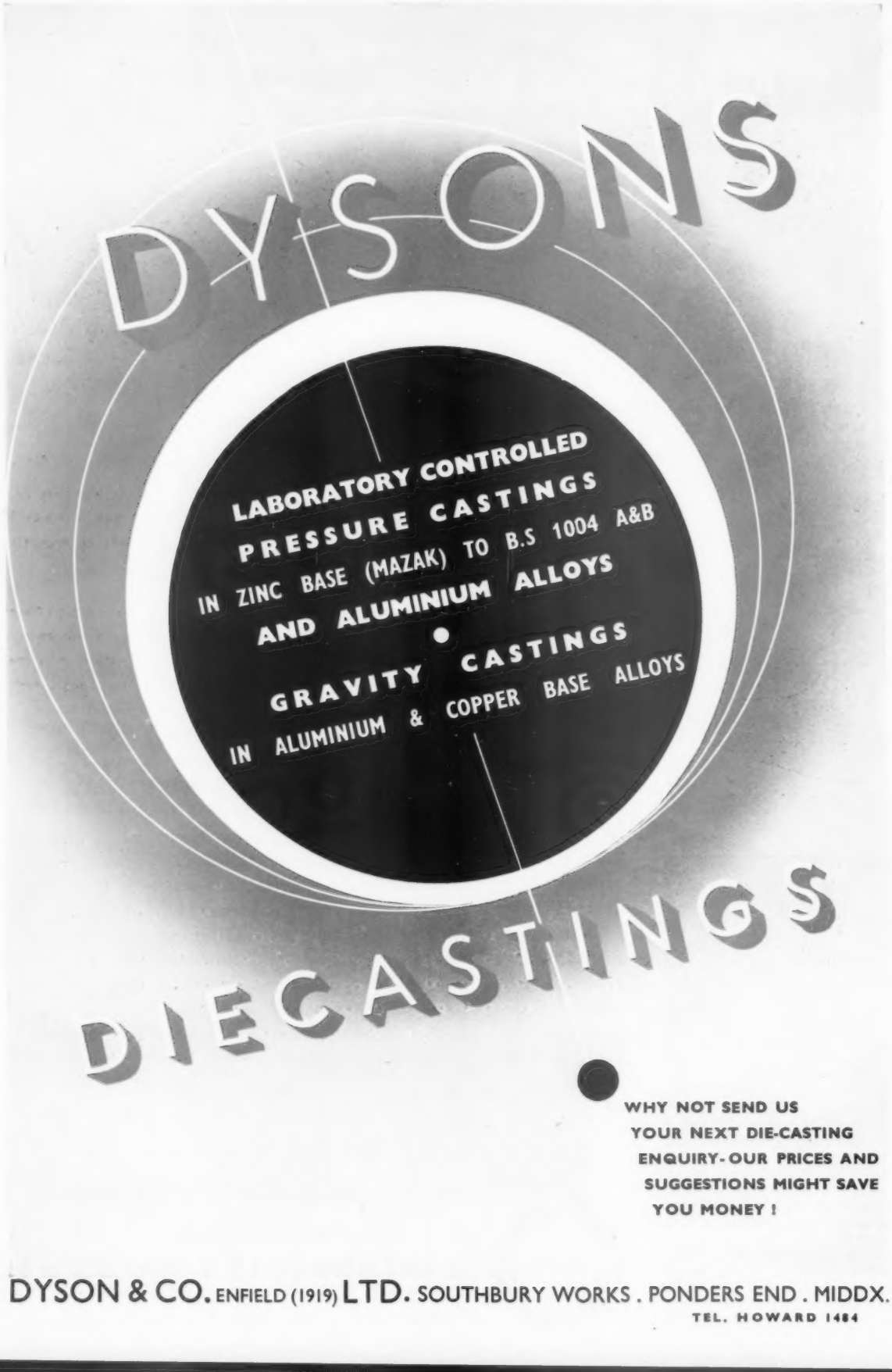
Shell Diala Oils are specially designed for electrical applications. They are recommended for transformers, oil-filled switchgear and capacitors, and for general insulating and dielectric purposes. Shell Diala Oil "B" complies with the British Standard Specification 148/1951.

The Seashell range of specialised industrial lubricants, which includes Shell Diala Oils, is marketed throughout the world. There is a Seashell grade for *every* industrial use—and each of these grades is available everywhere in the same high quality. Shell lubrication engineers will be pleased to provide further information and to make specific recommendations for particular purposes.

Shell *Diala* Oil

SHELL

LEADERSHIP IN LUBRICATION


DYSONS
LABORATORY CONTROLLED
PRESSURE CASTINGS
IN ZINC BASE (MAZAK) TO B.S 1004 A&B
AND ALUMINIUM ALLOYS
GRAVITY CASTINGS
IN ALUMINIUM & COPPER BASE ALLOYS
DIECASTINGS
WHY NOT SEND US
YOUR NEXT DIE-CASTING
ENQUIRY-OUR PRICES AND
SUGGESTIONS MIGHT SAVE
YOU MONEY !
DYSON & CO. ENFIELD (1919) LTD. SOUTHBURY WORKS . PONDERS END . MIDDX.
TEL. HOWARD 1484

stocks TREMENDOUS

"Know anything about stocks and shares, old boy?"

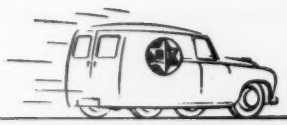
"Not a thing — except my stock with the old man — which has gone up recently."

"How come?"

"I've turned over to Monks & Crane for drills and cutting tools . . . and what with their stocks, I get all the share I want."

"Sounds a very good investment."

and shares FOR EVERYONE



BRITAIN'S FOREMOST DISTRIBUTORS

MONKS & CRANE LTD

THE TWIST DRILL SPECIALISTS

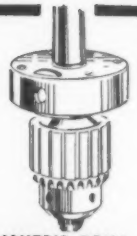
London Office:
295 EUSTON ROAD
LONDON, N.W.1
Tel: EUSton 5311 (3 lines)
Grams: Emancee, London

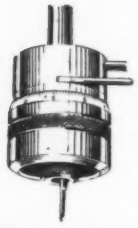
Head Office:
STANHOPE STREET
BIRMINGHAM, 12
Tel: Calthorpe 1381 (5 lines)
Grams: Emancee, Birmingham

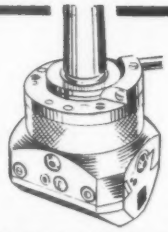
Manchester Office:
MANCHESTER OLD ROAD
RHODES, MANCHESTER
Tel: Middleton 3654 (3 lines)
Grams: Emancee, Middleton, Manchester

SM/MC 8039

NEW EQUIPMENT
for the machine shop

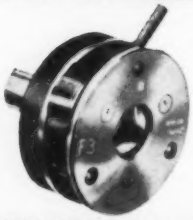
1

TOOL MAKER'S DRILL CHUCK

2

PROFILING HEAD

3

BORING & FACING HEADS

4

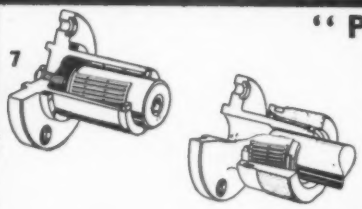
MULTI-SPINDLE HEADS

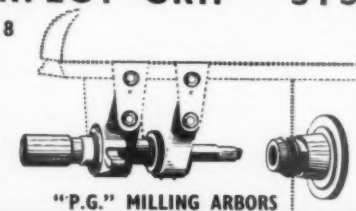
5

SELF-OPENING THREAD ROLLING HEADS

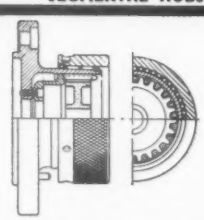
6

SEGMENTAL HOBS

"PERFECT GRIP" SYSTEM

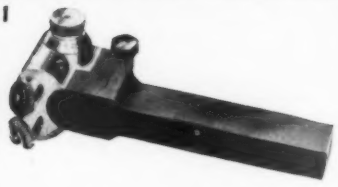
7

"P.G." CHUCKS, ARBORS & MANDRELS

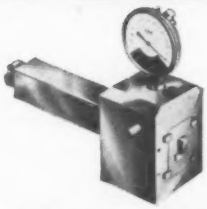
8

"P.G." MILLING ARBORS

9

"P.G." INTEGRAL CHUCKS

10

MAGNETIC DIAL GAUGE STAND

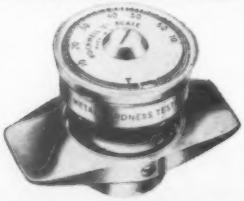
11

KNURL CUTTERS

12

MACHINABILITY COMPARATOR

13

INDICATOR PLUG GAUGES

FULL DETAILS OF THIS EQUIPMENT WILL GLADLY BE SENT UPON REQUEST.

14

PORTABLE HARDNESS TESTER

MSE

MACHINE SHOP EQUIPMENT LTD.

SPENSER STREET, LONDON, S.W.1

CROMWELL

3½" S.S. & S.C.

Super Precision Lathe with hardened and ground bed.

Fitted with Ward-Leonard type electric drive providing infinitely variable (stepless) speeds of 20–2000 r.p.m. Wide range of threads, feeds, etc.

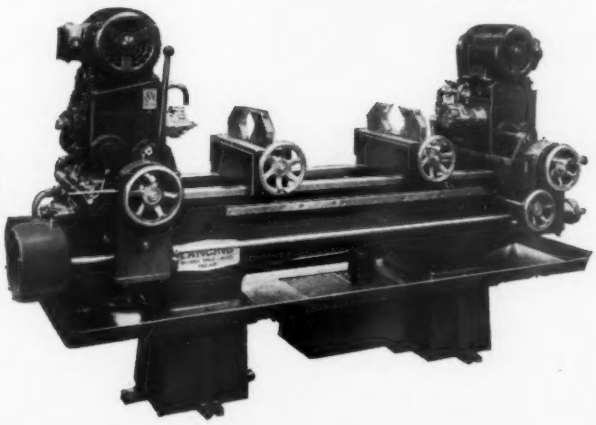
LANCING

MACHINE TOOLS LTD

COMMERCE WAY, LANCING, SUSSEX.

Telephone: Lancing 3410 *Telegrams: Lancer, Lancing*

LANCING
MACHINE TOOLS LTD



TRUCENTRE

MILLING & CENTRING MACHINES

For accurate and fast production–permitting rapid duplication of overall lengths and depth of centre. Three models (bar lengths 54", 90" and 120") all taking 5" dia. bar. Centre height 9" with possible swings of 18" and 20".

NEVEN TOOLS
speed the job!

A Customer's Comment :

Since using "Neven" Tools our cost per unit in the Tool Room has been reduced to a fraction of a ¼d. from 2½d. per unit when using other forms of diamond tools.

Over twenty years ago *Mr. Neven introduced his Impregnated Diamond Tools. Great technical advances have been made in succeeding years and production is still under the personal supervision of Mr. Neven. Our latest catalogue gives the widest range of Diamond Tools yet listed for working tungsten carbide, glass, quartz, stone, ceramics and hard refractories, etc.*

Keep right up to date by sending for a copy today.

NEVEN

IMPREGNATED DIAMOND PRODUCTS LTD · GLOUCESTER

TELEPHONE 21164 (3 LINES) TELEGRAMS IMPREG GLOUCESTER

Look at it from this angle

Not only as a fastener but also as an essential in your production planning that will meet with the most exacting requirements of your engineers . . . With new amazing accuracy, terrific toughness, superior tensile strength, backed by UNBRAKO service, research and development, they are helping to fulfil production demands with economy of time, material and cost.

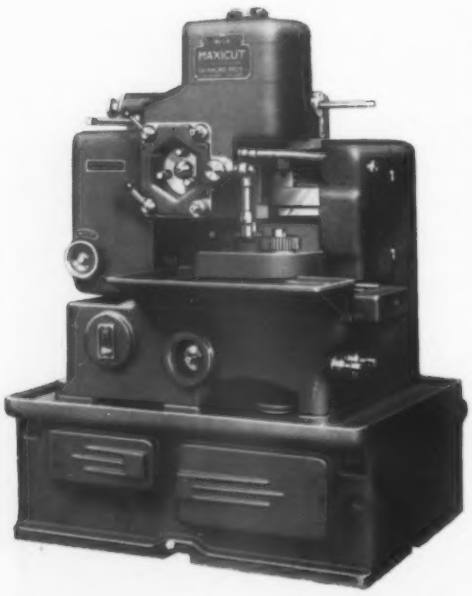
Available for immediate delivery. Send for free samples.

Manufacturers of Unbrako standard socket screws and special screws to A.I.D. requirements.

UNBRAKO make fasteners to help engineers produce more and better machinery in every industrial centre in the world.

UNBRAKO SOCKET SCREW CO. LTD.
COVENTRY ENGLAND

High Grade GEARS *at low Cost!*



The cost of gear production on the No. 2A MAXICUT is highly competitive and accuracy is second to none. It has a capacity of 7in. p.c.d. thus covering a wide range of gear requirements, will produce spur, helical or internal gears with equal efficiency. Special shapes may be produced also where unvarying repetition is required. *FULL PARTICULARS ON REQUEST.*

MAXICUT

PRODUCTION GEAR SHAPERS

DRUMMOND BROS. LTD. GUILDFORD, Eng.

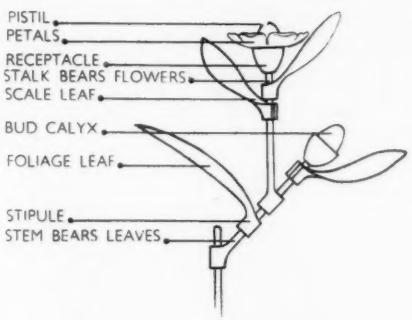
Sales and Service for the British Isles :
DRUMMOND-ASQUITH (SALES) LIMITED
KING EDWARD HOUSE, NEW STREET, BIRMINGHAM
Phone : Midland 3431 (5 lines) *Grams : Maxishape, B'ham*
Also at LONDON & GLASGOW

Anderson

Designer's Diary N.º 9

Reprints of this announcement will be sent on request.

For the second year in succession, A. H. Woodfull, M.S.I.A., Chief Designer of the B.I.P. Product Design Unit, has won the first prize in the annual competition for plastics design sponsored by the Worshipful Company of Horners. This constructional toy was his winning entry in the 1952 competition.



The Product. Although much has been done to provide children with constructional toys which stimulate imagination and develop manual skill, there is still considerable scope for toys with a direct educational value. The toy illustrated aims to foster an interest in botany, since a child needs at least to have an elementary understanding of natural plant growth before being able correctly to assemble the components.

The Design. The split heels of the standard leaf and stalk are a push-fit upon each other. The angles are arranged to provide an infinitely variable arrangement of the finished plant, overcoming any possibility of geometrical appearance.

The pot forms a natural pack for the components. The lid has a raised square platform with a pattern of blind holes which forms the foundation for plant building. The lid is secured by a cam-type locking device, instead of the more conventional threads, so that it can be easily opened and closed by quite a young child; this arrangement also provides a technical advantage in that both pot and lid can be moulded in straightforward 'up and down' moulds. When completed, the toy need not be dismantled immediately: its after use as an attractive floral decoration would give the child an extra sense of achievement.

The Materials. Beetle urea material, with its excellent colour range, is recommended for compression moulding the body and lid; ethyl cellulose—a tough material—for injection moulding the stalk and flower units. For the leaves, the leathery 'feel' and natural elasticity of polythene suggest it as an ideal material.

The B.I.P. Technical Advisory Service will assist industrial designers and manufacturers who use plastics mouldings in their production processes. Advice is freely offered regarding product styling, mould design, choice of materials and moulding techniques. The Service exists primarily to assist your own designers and technicians regarding those problems peculiar to plastics mouldings, with which only a specialist can be completely conversant.

BRITISH INDUSTRIAL PLASTICS LIMITED B·I·P GROUP **1 ARGYLL ST., LONDON, W.1**

'BEETLE' is a trade mark registered in Great Britain and in most countries of the world

MAXNOVO *Profilomatic*

Model A and U DUPLICATING —LATHE—

★ **AUTOMATIC MACHINE—MODEL A**

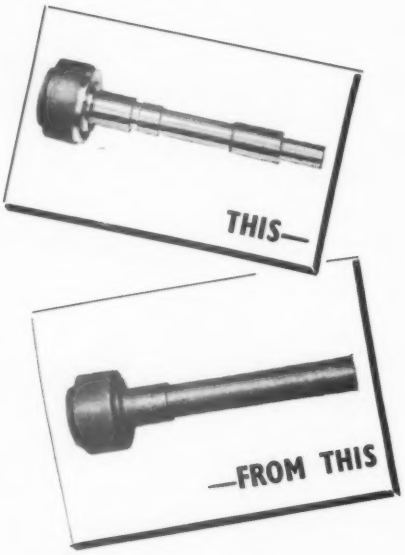
This machine automatically duplicates parts from a master or template; has automatic speed change and automatic feed change during the turning cycle. Automatic carriage return.

★ **UNIVERSAL MACHINE—MODEL U**

This machine has manual control of variation of speeds and feeds during the turning cycle and when not required for duplicating can be used as an ordinary lathe.

- Powerful headstock with large diameter pre-loaded ball bearings.
- Helical gears with ground teeth.
- Facing and forming slide.
- Capacity up to 4in. dia. by 14in., 23in. or 33in. long.
- Both these machines available for inspection at our showrooms.

★ We can also offer the Maxnovo Duplicating Attachment for fitting to your existing lathe.



PRODUCED IN 45 SECONDS . . .

Automobile gear shaft turned on the "Profilomatic" Model A automatic cycle Lathe in 45 seconds.

3 automatic feed changes and 2 automatic speed changes are made during the cycle.

CATMUR MACHINE TOOL CORPORATION LIMITED

103 LANCASTER ROAD · LADBROKE GROVE · LONDON · W.11 *'Phone PARK 9451/2*

Rathbone/1894

SPEEDICUT
FIRTH BROWN TOOLS LTD.
SPEEDICUT WORKS · CARLISLE ST. EAST · SHEFFIELD 4

It's not what they cost...

it's what they do!

It costs far more to keep taking a tool out and regrinding it than to use

STAG

ALLENITE

TUNGSTEN CARBIDE TIPPED TOOLS

and go on cutting indefinitely. Of course, there comes a time when even an Allenite tool has to be reground, but just keep a record and note the difference! For fastest cutting, highest rate of production, and longest life between grinds, on steel, cast iron and non-ferrous materials generally, where the application is suitable there's nothing to touch Allenite tools. Use them for mass production work with light cuts at high speeds.

Write for folder, using coupon.

To EDGAR ALLEN & CO., LTD.
SHEFFIELD, 9

Please post Allenite Booklet to:

Name .....

Firm .....

Address .....

.....

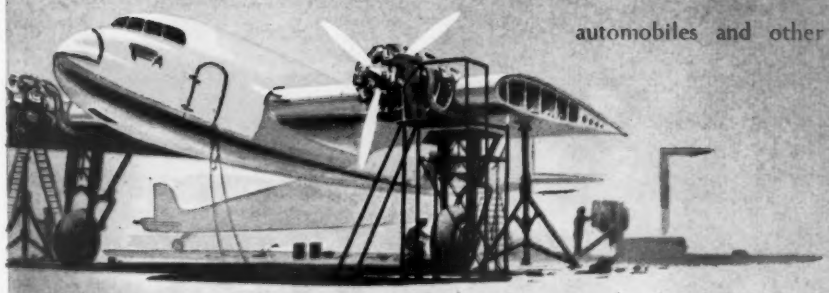
J.I.P.E.

EDGAR ALLEN & CO, LIMITED.
IMPERIAL STEEL WORKS:- SHEFFIELD.9

Telephone: SHEFFIELD 41054 Telegrams: ALLEN, SHEFFIELD 9

ALLOY STEELS

Unremitting care at every stage of manufacture and inspection enables designers to rely on Fox steels for high duty applications in aircraft, automobiles and other highly stressed machines.



THE UNITED STEEL COMPANIES LTD

SAMUEL FOX & COMPANY LIMITED

Associated with The United Steel Companies Limited

STOCKSBRIDGE WORKS · Near SHEFFIELD

U V A

INTERNAL GRINDING MACHINES

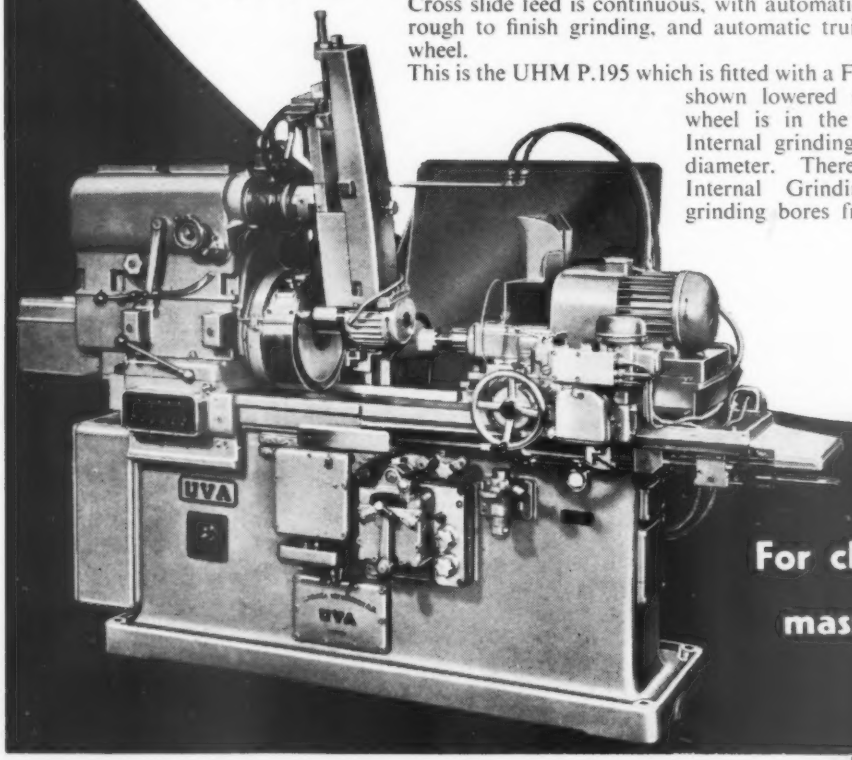
This range of machines is designed for fast and accurate automatic production on long runs. Two methods of automatic sizing are available; solid gauging for through holes, and Deltameter for blind holes or short length bores.

The pressure at which solid gauges are offered to the bore is variable, and the machine auto gauges to limits of 0.0003″.

The Deltameter performs an actual check on bore size by the contact of a diamond-tipped pointer within the bore, automatically sizing to limits of 0.0002″.

Cross slide feed is continuous, with automatic change-over from rough to finish grinding, and automatic truing of the grinding wheel.

This is the UHM P.195 which is fitted with a Face Grinding Head, shown lowered so that the facing wheel is in the grinding position. Internal grinding capacity $\frac{3}{4}$″ to 8″ diameter. There are other U.V.A. Internal Grinding Machines for grinding bores from $\frac{1}{2}$″ to 18″ dia.



For close tolerance mass production

WICKMAN *of* COVENTRY

LONDON · BRISTOL · BIRMINGHAM · MANCHESTER
LEEDS · GLASGOW · NEWCASTLE · BELFAST

Wickman

302F

The Institution of Production Engineers Journal

VOL. 32 NO. 5 MAY, 1953

An Expansionist Policy for Production*

MR. LINCOLN GORDON,

Chief of the United States Mutual Security Agency

Mission to the United Kingdom, sums up

IT is not Britain alone but the entire free world which depends on "an expansionist policy for production." We depend on such a policy not only for our economic stability and prosperity, but also for our security and survival.

The productive forces of the free countries have had a great burden placed on them in these post-war years. First, there was the task of reconstructing the plant that had been shattered or run down during the war. Then there was the struggle in many countries to bring peace-time production back first to pre-war levels and then beyond. Population and demand had increased during the war and production had to catch up. Finally, the tensions resulting from the threat and actuality of Soviet aggression have caused the free countries to rebuild their defences and these, too, have had to come out of the same production machine.

Only by an expansionist policy, of course, can all these needs be met. Each year there must be an increase in total production and, because of the relatively stable manpower situations in most countries, each year must see a rise in output per man. That is the only way we can provide for our essential defences and still maintain and improve our standards of living. And still greater expansion is required if the more advanced nations are, in addition, to provide the capital and goods required to speed the social and economic progress of the less developed countries of the world.

There is now apparently a general consensus that an expansion of production is not only desirable, but necessary. All the previous contributors to this series, for instance, have taken it for granted. That has not always been the case. In the Nineteen-Thirties there was an important school of thought which held that productive forces generally were over-expanded, that the only real problem was that of proper and effective distribution and that production in many fields should be kept in check. This was an understandable, if superficial, reaction to the economic crisis of those years. The current unanimity in favour of an expansionist approach is, therefore, an important and encouraging step forward.

But it is, of course, only the beginning. There is still a great gulf between a theoretical appreciation that expansion is required and an understanding of the steps that have to be taken to bring that expansion into being. And there is still another gulf, perhaps even wider than the first, between an understanding of these steps and a willingness to take them.

The previous articles in this series shed considerable light on some of Britain's most pressing requirements. If I may include the article on the British Productivity Council by Mr. S. P. Chambers of I.C.I. in the January issue, which was on the same general subject, the writers represented management, government, labour, and the engineering profession. Each naturally emphasised aspects of the problem which were closest to his field of operations.

Mr. Chambers noted the importance of making capital available for expansion and modernisation and of creating public awareness of this vital factor. Mr. Walter C. Puckey, of the Ministry of Supply, was concerned with the supply of Production Engineers, which must be stepped up substantially if industry is to make more rapid strides. Sir Vincent Tewson, of the T.U.C., stressed the need for bringing the workers into the picture at the point of production by a combined effort of management, trade unions and joint operations such as those of the British Productivity Council. Mr. Allan Ormerod, the textile Production Engineer, cited the contributions to be made by work study, proper maintenance, good machine design, careful choice of equipment and the most efficient utilisation of plant.

* See previous articles in January/April, 1953, issues of the Journal.

All of these, of course, are among the essential steps. If there had been more space or additional contributors, the list might well have been lengthened. On the technical side, it might have included also such items as improved materials handling and layout, greater standardisation and simplification, more attention to packaging, possible savings on finishing, greater efficiency in distribution and quicker dissemination of research results. On the non-technical side, there might have been added greater cost-consciousness at all levels, more effective use of management accounting, wider and more intensive foremanship training, greater interest in suggestion schemes and a vast increase of communications within industry, through a variety of means of works information designed to make every person in a plant feel part of a production team.

On the whole, there is beginning to emerge a general agreement in this country on many, if not most, of the steps that must be taken if Britain is to expand its production at the rate required to assure its industrial survival. The big question now is: What of the willingness to take these steps ?

There is no doubt about the progressive firms, large and small, that have kept pace with the best in any country. But no nation can live on the prestige of a few. It is the general average which determines a nation's fate. Is the vast bulk of industry in this country prepared to do all that it must for its own, and the nation's, future security ?

Fundamentally, there are only two types of motive which can lead to action in these fields. One is inspired by patriotism and the other by self-interest. Hitherto, the appeal to the individual has been largely on the former basis. *Britain* needs greater production to maintain her position as a world power. *Britain* as a whole is facing economic peril and, as Mr. Chambers points out, is being hard-pressed by increasing international competition. But, by and large, the appeal to the individual manager and worker has been on the grounds of the *nation's* advantage or danger, not his own. Much of the effective response has been on an altruistic basis. One's own firm or job is not seen to gain any immediate benefit or to be in immediate danger, but many things must be done to strengthen or to save the nation. So far this approach has brought a remarkable response from British industry and labour but, as is becoming quite clear, it is not nearly enough.

It may be proper, therefore, to ask this question: may the time now have come to consider seriously the other type of motive—that of self-interest ? This motive has two major aspects, self-advancement and self-preservation. The former has received considerable encouragement from the new Budget. The tax concessions on earnings applied to re-equipment and expansion of plant should go a considerable way toward solving the problem of capital availability noted by Mr. Chambers. But apart from anything the Government may do, may it not be possible that the earning motive needs fuller scope to be fully effective in promoting Britain's industrial expansion and national prosperity ? It might help, perhaps, if individual firms were not hampered by privately fixed restrictions from reaping the greatest advantage from the progress they make in improving efficiency and lowering costs and prices. If they succeeded in this direction, would they not have a greater incentive if they were free to acquire whatever share of the market came to them ?

With respect to self-preservation, likewise, Britain as a whole is under extreme pressure to expand its production and increase its efficiency so that it can compete in product, price and delivery on the world market. But so far, in many industries, individual firms have been insulated from this pressure. It would seem that the sooner that pressure could be brought to bear on each firm in Britain, the sooner might all the necessary steps be taken to improve efficiency and production and the sooner might the pressure be relieved from the nation as a whole.

The one lever that might be supplied to set most of the gears of an expansionist policy in motion would, therefore, seem to be a greater degree of domestic competition. I think Mr. Ormerod summarised the situation most clearly in this sentence in his article last month:

" Indeed, there is evidence to suggest that much of the inertia and lack of co-operation in industry is self-imposed from within and not the result of external influences."

It has been said that a large part of British industry is protected against the fresh breezes of competition by networks of price agreements, exclusive bargaining arrangements, collective boycotts, divisions of markets and other self-imposed restrictions. Is it not possible that these remove one of the strongest spurs to increased efficiency and production ? As long as they prevail, can one truly expect " an expansionist policy of production " ? For there is no good " business " reason why firms should take any steps which do not lead to substantial additional returns for them, or which are not necessary to stay in business. And most firms everywhere in the world do things mainly for business reasons and not in response to exhortation, no matter what the source nor how urgently given.

It is at least a possibility worth considering that virtually all the steps, mentioned in the previous articles, which industry must take to carry out an expansionist policy might be enormously encouraged if competition were given fuller play.

To be effective in assuring greater efficiency, competition cannot be at the expense of the worker, whether in wages, hours or working conditions. And in a country where labour is so well organised, there should be little fear that this would happen. As a result of higher productivity, not only would many costs and prices be lower, but wages would ultimately be higher.

This has been essentially the domestic American experience, which of course may not be entirely applicable to other countries but which, on the other hand, cannot be completely ignored.

Britain depends for its existence on industrial production more than does any other country in the world. It lives on its industrial exports. It is compelled to meet international competition. In many industries, it would seem to stand a better chance of success if individual firms were prepared to meet their rivals after competitive training on their home ground. To be sure in international trade, other countries, including the United States, have their parts to play. But regardless of what happened elsewhere, Britain would still lose out if entire industries drove themselves out of world markets by restrictive agreements and complacent business attitudes at home.

In this Coronation year, the British nation is being called upon once more to rediscover its adventurous spirit for a new Elizabethan era.

With so few geographical frontiers left to penetrate, the most challenging adventures today may be in the field of ideas. It is probably a bolder and more difficult thing for anyone to change long-held attitudes than it was for Drake and his men to sail into uncharted seas.

It is important for the people of Britain that the spirit of competition and adventure be revived in British industry. It is equally important for the whole free world. For a strong and prosperous Britain is an essential element in the preservation of the democratic way of life and the creation of a world of peace, freedom and plenty.

" An Expansionist Policy for Production "

In view of the wide interest which has been shown in these articles, they are being reprinted in booklet form and will be available at 2/6 *per copy, post free. Application should be made to: The Secretary, Institution of Production Engineers,* 36, *Portman Square, London, W.*1.

Mr. Allan Ormerod's Article—April, 1953

It will have been obvious to members that Mr. Allan Ormerod's leading article in the April Journal was incomplete. The Institution apologises to the author for this unfortunate omission; the concluding paragraphs are published in full below :—

" Double-day shift working has a contribution to make to an expansionist policy for production, provided that it is only used where an intelligent appreciation shows it to be advantageous. Some of the circumstances under which this may apply are as follows :—

1. Where *high-cost* equipment is installed and a fairly rapid recovery of risk capital is essential.
2. Where margin conditions so desensitise the cost of manufacture of a product that profit tends to be proportional to output.
3. Where the demand for a certain product lapses and the labour can be switched to double shift operation on other machines which previously ran single shift on a product for which there is an unsatisfied demand.
4. Where a proportion of existing machine space is to be sacrificed to some new development or process, and less machinery is available to sustain the single-shift capacity of associated processes.
5. To reduce the stock of work in progress per unit of output.

" Individual applications will require individual treatment and decisions will frequently have to be made on marginal indications—unless the labour-cost element of the total cost is relatively small compared with the fixed and semi-fixed expenses. Where the proposed change to shift working shows a break-even condition, or even a slight increase in cost per unit of production, it may be advantageous to make it provided that an increased gross margin results. Unless and until organised labour is realistic in its conception of what constitutes reasonable shift-hours and shift-premiums, shift-working can never be a general stimulant to capital development. Only in these circumstances can shift working become the catalyst to rapid technological change."

FUTURE PROSPECTS OF THE PRODUCTION ENGINEER

by WALTER C. PUCKEY, M.I.Prod.E., F.I.I.A.

Presented to the Lincoln Section of the Institution on 2nd October, 1952, to the Reading Section on 4th December, 1952, and to the Luton Section on 29th February, 1953.

Mr. Walter C. Puckey

Mr. Puckey, Deputy Controller of Supplies (Aircraft Production), Ministry of Supply, and a Vice-President of the Institution, is well known to members for his valuable service and progressive leadership in Institution activities.

He has served as Chairman of a number of Institution Committees, and was Chairman of Council between 1950 and 1952.

I HAVE never been engaged in the manufacture of crystal balls and cannot, therefore, be counted an expert on forecasting the future. I have, however, a few qualifications to talk about the future of the Production Engineer. I am one, I have been interested in myself for years, and I have played a small part in our Institutional affairs for some considerable time. Whether you agree that my past justifies me talking of our future I will know later when I hope to get the benefit of your important views.

How far can the progress of a group, such as this Institution, be independent of its environment ? Surely our progress depends on at least two qualities; one, an ability to provide, preferably in advance, those techniques that our nation itself needs to make progress and, two, the ability and enthusiasm of our members to put the techniques to work. I propose in this Paper to examine both possibilities and come to certain conclusions which I invite you constructively to tear up if you wish, or improve upon if you can.

How Goes the Nation ?

" Only just " is the obvious answer. Since 1945 we have laboured hard to solve the troubles thrust upon us by our mighty war effort, our loss of overseas investments and our corresponding load of overseas debts. We have planned our way from one crisis to another, and most of the remedies have been palliatives, not cures.

Governments of two complexions have applied few fundamental changes, and their three common problem children have been—

(1) Control, in one form or another, ranging from currants to currency.

(2) The balance of payments, which means more and more exports with less and less imports.

(3) Taxation of everything and everybody.

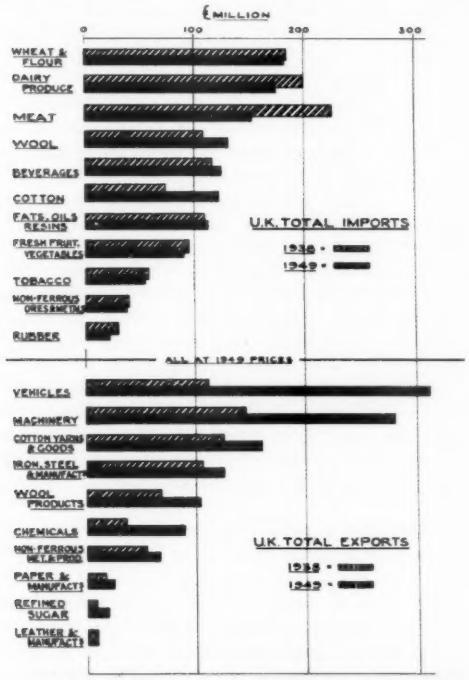
Can we honestly see any future in such remedies ? What a state of affairs exists when our country has put up for years on end with food rationing such as we (and almost we alone) still have. I have just refreshed my memory on meat rationing, and find to my horror that since the War we have made 32 changes in the ration ! I won't dwell on all the other controls still existing and which are almost taken for granted. I will quote only one other example which is, to me, particularly irksome, if only because our Empire was founded on travel and exploration. To-day we need more international understanding than ever, and we get less financial encouragement to see how others live. Taking our nearest neighbour, France, as an example, we have since the war altered the travel allowance eight times, with the present sum* smaller than all except one of its predecessors.

The Balance of Payments

Many controls are, of course, necessary to cope with Problem (2)—our balance of payments, and

*at December, 1952.

Cabinet Ministers who have been in office since the war will have 'Balance of Payments' engraved on their hearts when they die. How vulnerable we are to the chill winds of world competition! We have for years been continually exhorted to export, and how well we have responded; yet despite all efforts we dived into the waves of another economic crisis last year, and we are on the verge of another export drive which is bound to be more difficult than the last. We are a manufacturing nation, unable to manufacture without considerable imports of material, and unable completely to feed ourselves either. And so we resolve in a vicious circle.



OUR PRINCIPAL IMPORTS & EXPORTS

Fig. 1

What is the pattern of our imports? Let us look at Fig. 1 and realise how much we rely on them to maintain our exports and, indeed, our standard of living.

Perhaps we had better look at the pattern of export trade also. In Fig. 1 I have, by the way, ignored invisible exports. Notice, incidentally, how much we now rely on the metal using industries for major exports, and incidentally on the Production Engineer.

What a fine export job British industry has done! We have often (and rightly) been accused of unreliability in deliveries, but in sheer volume we have done well. Can we do better? Certainly, in some industries such as aircraft, where we have something new to offer; in all too many commodities an export effort will face much greater competition from other exporters, while the demand may drop in the country originally buying from us.

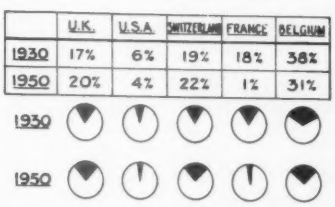
If we accept the fact that exports are necessary only to pay for imports, how much more can we limit imports! Fig. 1 showed us that the largest import items are wheat, flour, dairy produce, meat and wool. Can we limit these commodities still more without serious harm to morale and efficiency? I doubt it, unless, and this is the crux of the matter, unless we can provide suitable alternatives at home. If, for instance, our farmers could provide more wheat without a proportionate loss in other products then we win out on our balance of payments. If we can use a home-provided raw material instead of one that is imported, we win out.

If, however, we carry on at the present rate we shall continue to face recurring crises, with each tightening of the belt a restriction on our greatness our movement and our standard of life.

Let us consider more statistics. In Fig. 2 we show export figures as a percentage of total trade in a few important countries. In the U.S.A., for instance, it is not as vital to their economy when the steel workers get an increase of 21 cents/hour and the price of steel goes up by $5.20/ton. It is largely an internal transaction, with the corresponding inflation doing little harm to the average person (fixed income "unfortunates" excepted). America's export trade, being relatively small, is little affected. Such an increase in costs here, however, particularly on engineering products, would be serious unless accompanied by increased output per man, as we would have no alternative but to pass on the increase to would-be customers abroad. They would probably soon become 'won't be' customers!

Let us remember too that while many countries can do without *our* exports, we cannot do without some of *theirs*. Australia, Canada, India and many other countries are expanding their own manufacturing industries, and Australia may well say: "Why export wool to Britain only for Britain to re-export it as clothing? We will make the clothing". Canada, for instance, can do without a British machine tool, but Britain must still rely on Canadian wheat. Let us share a hope in passing that more sensible interchange of trade will take place between all countries, because there is no future in any country which pushes exports and bans imports.

	U.K.	U.S.A.	SWITZERLAND	FRANCE	BELGIUM
1930	17%	6%	19%	18%	38%
1950	20%	4%	22%	1%	31%



EXPORT TRADE AS % OF NATIONAL INCOME

* IN EXPORTS GOLD AND INVISIBLES HAVE BEEN EXCLUDED

Fig. 2

Despite this statement, I think we must face the fact that world trends indicate how much other countries have taken unto themselves the manufacture of so many things formerly made only by the few. Many products can be made by relatively untrained labour as long as the designs and Production Engineers are available, and national pride being what it is, we must expect these trends to continue in those countries not yet developed industrially. Britain must rely more on her ideas, her capital goods, her ability to sell things others cannot afford, or do not have the skill to make.

Taxation

The third problem child in that somewhat shaky Government family is taxation, and everyone in this room realises its impact. How true is the notice in a certain tax office which reminds us that "a little of what you earn belongs to you". In recent years we have seen a rise in nearly all forms of taxation, and I see little scope for reduction. If so, it means that we are called upon to make even greater efforts for smaller company and personal rewards, and there are plenty of signs that the law of diminishing returns is beginning to operate.

The Place of the Production Engineer

How does the Production Engineer fit into this somewhat gloomy picture? Does he follow the national trend, or is he significant enough to break new ground and lay new paths towards a better Britain? Perhaps this is too much to ask of any one group, but Britain is our business and we can only truly do our job if we consider constantly the wider problems within which we discuss our own.

I believe that our progress depends on two qualities: ability to anticipate the national need, and enthusiasm to realise our objectives. Of the second I will only say this: of all the bodies to which I have belonged I have felt more at home in our Institution. Its rapid growth and status have been possible only through more than usual enthusiasm. If we harness this to clear objectives we cannot go wrong: indeed we will do well for the country.

I have said that Governments, since the war, have concentrated on three major factors which are to-day as troublesome as they were some years ago. They are—

(1) Controls.
(2) Exports and Imports (Balance of Payments).
(3) Taxation.

Let us explore these three problems more thoroughly:—

(1) *Controls*

The necessity for controls springs largely from our adverse balance of payments, and although irksome and restrictive, controls are symptomatic rather than fundamental. I do not believe that either of our two major political parties favours controls for their own sake, although at times one wonders why greater chances are not taken to consign a few more to the bonfire. I have, frankly, expected more from the present Government.

(2) *Exports and Imports*

Fifty million people take a lot of feeding, and British agriculture at present feeds about half of us. Nearly 60% of our food is imported, including, of course, such simple luxuries as oranges and bananas. Farmers have risen well to the occasion, but the pressure of appetite and population is against them, despite the terrific increase in mechanisation and output per man on the farm. Here indeed is the realisation in part of a Production Engineer's dream—an expanding market with relatively easy access to mechanical and financial aids. The only thing not guaranteed has been the weather! Yet despite all this farmers are fighting a losing battle with, at present, little chance of doing more than holding their own in the balance of payment, or the population problem.

How does this concern Production Engineers? In my view a much greater utilisation of our soil must take place; indeed, a recent American report foreshadows a 200% increase per acre by 1975 if farmers really try. I am convinced that, just as we have played our part in making tractors and a whole mass of other agricultural equipment, so we shall help to forge an even closer link between farming and industry. The business-man farmer has come to stay, and his further influence may alter profoundly, politically, economically and socially the relationship between urban and rural activities.

I am sure you read with great interest Professor Hill's recent address to the British Association. There he referred to one of the great problems of the world—how we can feed the vastly increased population of the future. Let me quote a relevant passage—he says:—

"The dilemma is this. All the impulses of decent humanity, all the dictates of religion, and all the traditions of medicine insist that suffering should be relieved, curable disease cured, preventable disease prevented. In many parts of the world advances in public health, improved sanitation, the avoidance of epidemics, the lowering of infantile death rates, and a prolongation of the span of life have led to a vast increase of population. For many years to come the shortage of natural resources, particularly of food, is bound to produce increasing deprivation and

	CONSUMPTION (TONS)		% WE IMPORT OF OUR TOTAL REQUIREMENTS	
	1938	1951	1938	1951
IRON ORE	16,347,700	22,005,400	32%	40%
MOLYBDENUM	N.A.	1,765	N.A.	99%
COPPER	255,000	330,000	139%	107%
CHROME ORE (METALLURGICAL ONLY)	N.A.	27,000	N.A.	93%
ALUMINIUM (VIRGIN)	44,000	202,904	114%	87%
TUNGSTEN	N.A.	3,070	N.A.	100%

IMPORTS OF CERTAIN METALS

Fig. 3

disturbance. There is more than danger that the emergency will result in an over-use of natural resources leading to permanent and irretrievable loss."

Better hygiene and medical services prevent many from dying, but can we prevent them from starving ? In the U.S.A. alone the population will increase by 42 millions by 1975, with a *working* population increase of only 20 millions. What a production engineering job to face !

Let us turn to another vital group of materials, those covered by the term " metal-using industries ". Fig. 3 shows the import situation on a small range of important metals. Note our great reliance on importation of these materials, and realise also how much the Government relies on the metal-using group of industries to take the added strain on the export rope made necessary by the relative losses of other exports such as textiles.

But this does not reveal the full seriousness of the future materials problem. How many of you have read a report called " Resources for Freedom ", prepared in the U.S.A. by the President's Materials Policy Commission ? Its five volumes are indeed most impressive, and the conclusions apply to Britain just as to the U.S.A. herself. Indeed they apply more, owing to our precarious position. I cannot do better than give you an appendix which summarises just a few significant sections of this fine work. Notice how the diagnosis compares with that of Professor Hill.

We face, then, a prospective world demand for goods in excess of basic material possibilities, and this can only mean (a) a raising of price levels because of more serious competition for scarce materials, and (b) a more active programme of material economy, or utilisation, call it what you will, combined, no doubt, with a corresponding drive to use alternatives. The stark alternative is a lowering of our standard of life.

Within the metal industries alone is a vast programme for our future Production Engineer. He and the research worker must make 1 lb. of metal do what to-day requires two. It will be accomplished by new metals, better specification, improved strength-weight ratios, utilisation of materials supplied largely from home sources and, last but not least, less waste in the manufacturing process.

Let me quote a few examples to illustrate the possibilities. How many Production Engineers know of the possibilities of new metals such as titanium alloys ? Titanium is to-day where aluminium was years ago, and it is bound to become a great metal of the future. For instance, the full use of titanium in a modern jet engine would reduce weight by hundreds of pounds—a vital contribution. But it isn't yet available in quantity in Britain, and we know very little about its qualities of fabrication. What a chance for production engineering research !

Glass, largely home produced, can be used as a metal substitute on many things from saucepan lids to the pipes shown in Fig. 4. We read only recently that Mr. Fox, who designed the Duke of Edinburgh's yacht, is experimenting with glass fibre instead of imported mahogany. This material is also being experimented with on many aircraft components, and as an extruding lubricant. I could quote cases where plastic parts have replaced metal with no detriment to cost or efficiency, and you know of many other cases.

Another example deals with the possibilities which exist in reducing the great waste caused by present production methods. Fig. 5 may be an extreme case, but there are plenty like it. It shows a steel casting for a modern jet engine, and illustrates the tremendous direct and indirect waste between raw casting and finished part. Here we see the cast product, made incidentally in high grade alloy. Its cast weight is 1,600 lbs. It is then rough machined, with 1,350 lbs of swarf hogged off it by such expensive machines as those in Fig 6. Fig. 7 shows the finished job, weighing only 79 lbs. Don't assume, as some do, that all the swarf is remelted with no waste. We have, in fact, at least two sources of waste in this one example. First, out of 100 lbs. of metal, 12% is lost, thus producing a nett casting weight of only 88 lbs. Here alone there are many possibilities of improvement, because quite apart from metal loss we lose in fuel, in furnace upkeep, etc.

Then we have a second loss in the tremendous time and money required to reduce a casting from 1,600 lbs. to 79 lbs. How much a pound does that swarf really cost when you amortise the machine tools shown in Fig. 6 ? These tools require brains, skill, metals, buildings, which all line up in an expensive

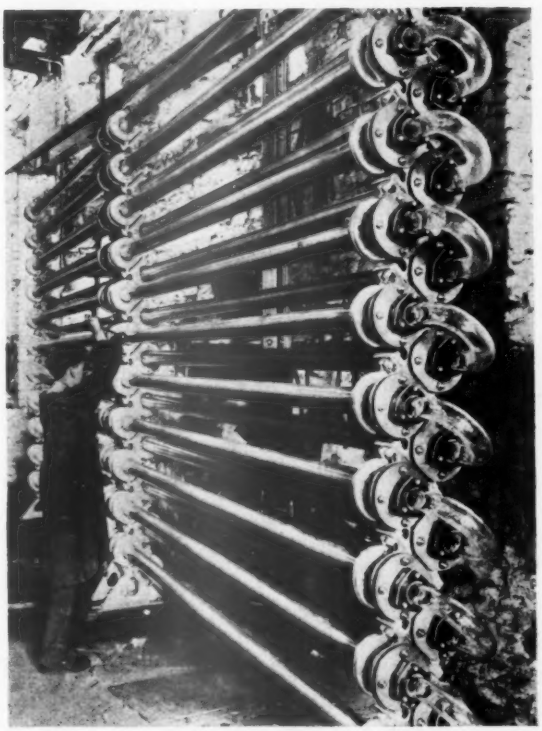


Fig. 4

Fig. 5

Fig. 7

row behind the swarf. Have you recently calculated the percentage of your total weight of incoming material that goes out as useful goods ?

One complaint I have heard is that few designers and Production Engineers know authoritatively what are the world trends of materials within which they should design and plan to produce. It is a fair comment and, obviously, the most direct approach is to consider what percentage of your designs rely upon imported materials. Action might then be started to reduce this percentage progressively.

I could dwell much longer on this section of my Paper, but surely enough has been said to show that under this section alone—the minimising of imports—you have an important future. Let us summarise our future activities into three main divisions :—

(1) Analysis of future material requirements into the two categories of imported or indigenous materials.

(2) Preparation of a programme showing a progressive relative reduction of imported materials.

Fig. 6

(3) Fuller *utilisation* of essential imported materials.

You will notice that I have not referred here to the fuller utilisation of *all* materials. I will come back to this later on.

(3) *Taxation*

I have no remedies for high taxation beyond those which would put me in court for murder or evasion. We must, I think, work on the basis that never again will we escape the privilege of paying heavily for running the nation, and we might as well face the possibility of applying taxation more sensibly rather than dodging it.

Please don't think this is complacency. I see all too vividly the impact of staggering taxation on our morale and our company balance sheets. I will leave morale alone in this Paper, and concentrate more on how the Production Engineer can help to minimise the effect of continual high taxation. High taxation brings at least two problems :—

(1) Reduction in enterprise, particularly as applied to long-term research and development.

(2) Letting the plant run down because we cannot afford expensive replacement costs.

Never will a nation be more in need of research and development than ours. A recent report by the F.B.I. shows us that since 1946, the date of the previous survey, an increase of more than 50% in research expenditure was made by the firms included in the survey. The number of qualified staff had increased by 52%, giving an average of 100 per firm on research and development. Of this 100 about 25 were qualified by degree, H.N.C. or equivalent. Unfortunately, no statistics on *Production* research and development are separated, but my guess is that the number so engaged is small—too small. It is an opportunity which our successors will do well to encourage.

A Common Error

Do you, as a Manager or Production Engineer, fall into the common error of assuming that research

and development applies only to the *product* you make, or do you apply it equally to production ? Look at Fig. 8 and tell me later whether you agree with it. How many companies of reasonable size recognise the value of a Production Engineering research and development group working back of the Production Engineer, just as the Research and Development Engineer works back of the Product Designer ? Yet the need is just as great and the rewards as lucrative.

I first saw the value of production research in the U.S.A. some years ago, where in a certain large company over 100 people were in a special department under the Chief Production Engineer, and were, to quote him, " looking over the heads of the regular production men into the shape of production to come."

When I became a temporary Civil Servant 18 months ago, one of the first things I did was to set up a Directorate of Production Development. What a lot of new and fascinating production prospects it has uncovered, and how important it is to encourage their development and application to a wider sphere. I will refer to a few of them later on, but right here let me put in a special plea to those controlling company policy. Don't economise on research into your product *or* your production. This nation has many great inventions to its credit, of which recent examples are radar, atomic theory, the jet engine and fine aircraft. The Comet, for instance, has a conversion value 20 times that of a motor car; in other words, the world will pay well for British brains and skill rather than materials, many of which originally have to be purchased abroad at ever higher prices. The Swiss watch has a few pence worth of imported material, but many shillings worth of exported Swiss skill.

Reluctance to Speed

The second reaction to high taxation is a reluctance to spend ever-increasing sums on replacing obsolete or obsolescent plant and layouts, and " The Economist " said recently that " the British community is now making hardly any provision at all for its own future." The present defence activity has at least one virtue in making our industries potentially stronger through the large programme of re-equipment, and 35,000 machine tools from all over the world cannot be installed in British factories without great gain to our productive strength. Unfortunately, many signs show that, with the trend of product design, much larger productive machines are required which may be beyond the financial power of any one company to buy and use. Let me quote the example of stressed wing sections on aircraft. Here you find that designs call for productive plant which costs in the millions before it is ready for use, and paradoxically, the actual quantity of parts to be produced may be relatively small. To quote a recent writer " the atom bomb will enable a few bombers to do what 1,000 bombers could not do some years ago." Tooling and equipment costs may therefore be a much heavier percentage of total manufacturing cost than ever before, and this alone will pose many

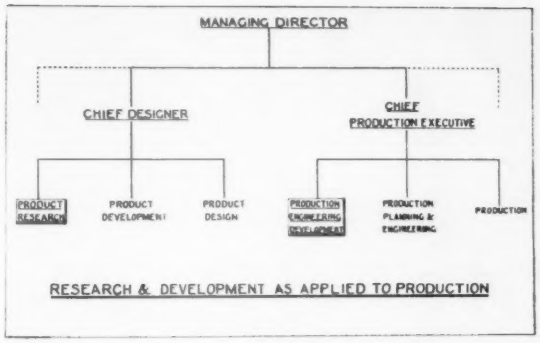


Fig. 8

questions for both the accountant and the Production Engineer. I am convinced, for instance, that the era of the special purpose machine tool is passing, although there will always be certain applications to high production articles. I believe that the Production Engineer of the future must, more than before, develop universal machines and flexible layouts able to make small quantities economically without exorbitant tooling costs. He must be able to change production lines over more rapidly to satisfy variations of design required by our customers, who, particularly those overseas, will be less tolerant than they have been since the War. He will find, too, that because of greater design intricacy the development time will be longer, and the time left over for production correspondingly shorter.

A recent advertisement in an American publication describes a Company's " flex shop," where rush orders are undertaken. I think the whole factory may well be the " flex shop " of the future.

It is interesting to note that many attempts are already being made to anticipate this trend. An examination of the new features at the 1952 Machine Tool Exhibition reveals such things as hydraulic copying lathes having a templet holder with nine stations, thus enabling nine different parts to be produced without re-setting the machine. This is quite a contribution to the short production runs I have mentioned earlier. Then we have a multiple tool post which allows sets of tools to be repeatedly interchanged. This again will facilitate small batch production by enabling different components to be finished in quick succession without re-setting the tools after the original set-up has been prepared. We find, also, an electronically (what next !) controlled spacing table which, used under a vertical drilling machine, enables holes to be precisely and quickly located without jigs. From Germany we find a Universal hydraulic grinder with a triple wheel head which enables the machine to be changed over rapidly from one operation to another.

I came across a simple little idea in an aircraft works the other day, where an attempt had been made to minimise the heavy gauging cost involved in checking profiles on sheet metal parts. Fig. 9 shows us a base plate having adjustable brackets which are quickly set to a sample. A clever feature is the use of grooved brackets which if required can

Fig. 9

locate a limit plug gauge for checking tolerances.

All such things are really designed to make the basic productive machines more flexible and universal without adding too much to the skill requirements of the operator, which is a very important point, because a large jobbing shop usually requires a higher percentage of skilled labour, which the nation won't have. We must, therefore, minimise demands on skill as well as expenditure on tooling, and such a piece of production research is essential to meet future requirements.

One important effect of this trend in machine design will be to change the relationship in cost between the amount spent on the basic machine and its accessories, which might in future be classed as "tooling," or "animated fixtures." Let me show you a modern example.

Fig. 10 shows diagrammatically a component in a jig, and being drilled by a multi-head machine. On the right is a set-up of the future where the jig is identical but is remounted on a standard table and has bayonet-fitting drill bushes, on to which are clipped special portable drill spindles. These spindles, now under development, have self-contained electro-hydraulic feeds, and can be set to drill automatically to depth and then retire. You can attach any reasonable number of these spindles to a jig, so converting the latter into a temporary drilling machine. I am sure that unit heads of this sort have great development, and the Machine Tool Exhibition shows many interesting trends.

What are the advantages of this form of set-up ? First, expenditure on the drilling machines proper is reduced, with all its attendant savings in materials, space and skill. Second, the layout is potentially more flexible. Third, the taxation problem may be helped, although here I speculate rather than dogmatise. Let me explain more fully.

A machine tool is usually amortised or written down in value each year. Most progressive firms do this as rapidly as possible, but Tax authorities only allow a certain scale, which is usually not enough for modern needs.

Tooling costs are, of course, usually allowed to be written off immediately, or over the anticipated life of the product, and the effect of minimising the machine tool content and maximising the tool accessory content might, under present conditions, relieve the burden of taxation and help to keep the plant modern. Some further study of this trend and its implications would be worth while.

Before completing this section I will refer to another trend which affects the Production Engineer. Nearly every tendency is to increase the percentage of machining hours or mechanical fabrication in a product, with a corresponding reduction in fitting or assembly hours. A modern aircraft has about three to four times the number of intricate forgings, and four to five times the number of machining hours as its predecessors of eight years ago. Many firms are re-training fitters into machine workers, and every such trend magnifies the problems of the Production Engineer, and the demands to be made upon him.

Greater Utilisation of Home Resources

I said earlier that it was particularly important to minimise and economise on imported materials. Is it not important also to make better use of our *home* resources, including those vital twins, brains and hands ? If we had a surplus of coal over home demands we should more readily sell it as an export. If we could produce a chemical more cheaply we should more readily find an export market. If we produced more ideas we would attract more overseas customers such as the hundreds who came to visit Farnborough Air Show recently. The Comet airliner is a typical case where British designers have produced everything except an adequate number of aircraft in time to satisfy world customers. Its future rests largely with the Production Engineer.

Look at the trends in Fig. 11 and sharpen your imagination on how they will continue over the next 25 years. It is no use a propellor manufacturer suddenly finding that jet engines have ruined his business, or conversely, for the agricultural machine producer to have faint heart. Plans must be made based on international trends.

What a challenge to our Production Engineers who must translate every new idea into sales volume ! Do not forget too that the Production Development Engineer has *his* new ideas too, which his colleagues must translate into practice. Here are a few gleams in the eye which are at present only on the fringe

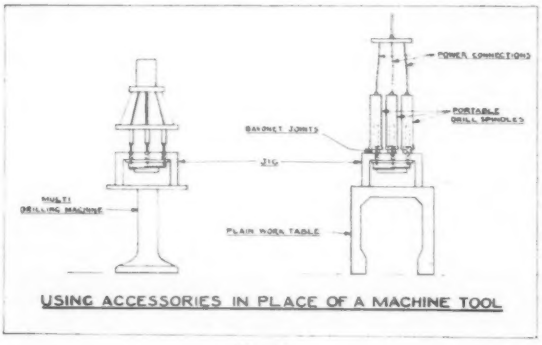


Fig. 10

WORLD PRODUCT TREND

This table shows the changes in the percentage share in world trade of different groups of manufactures over the last half-century. The figures were calculated from returns of the leading industrial countries by Mr. M. Tyszynski, of Manchester University, and published in his article "World Trade in Manufactured Commodities 1899-1950" in the Manchester School of Economic and Social Studies, September, 1951.

	1899	1911	1929	1937	1950
DECLINING					
Textiles	33.5	28.8	24.1	18.9	17.3
Clothing	6.9	6.3	5.4	3.2	2.2
Railways, ships, etc.	4.2	3.7	2.8	2.4	3.5
EXPANDING					
Industrial equipment	6.1	7.9	9.1	10.8	13.6
Electrical goods	0.9	2.4	3.9	4.7	5.7
Vehicles, etc.	0.4	3.3	8.4	9.4	11.8
Agricultural equipment	0.9	1.2	1.7	1.4	3.1

Fig. 11

of utilisation. Fig. 12 shows diagrammatically the continuous casting of metal. Just imagine the floor space and transport saved, and speeding up of process and delivery times, and the cost saving of such an achievement, where you can literally convert molten metal to lengths of section bar in a matter of minutes.

Or take the possibilities inherent in precision casting of metal. I have here some samples cast by the mercury process, which produces extremely accurate castings in many metals, including alloy steel, with a surface finish, in these examples, of about 50 micro inches.

Then we have processes such as Redux, which is used in the Comet to such good effect. This form of process, involving fastening by sticking, is bound to have a great future.

Many foundry men present have heard of Shell Moulding. The magazine "Life" described it as the first real change in foundry technology for several thousand years, and it may well revolutionise the relationship between foundry and machine shop. It certainly takes a great deal of both skill and dirt out of foundry work, and produces castings more accurate than those normally sand cast. Its effect on layout and transport may be profound.

All these and many more developments are just round the corner, and their development and exploration call for qualities and training not universally possessed by today's typical Production Engineer. These developments, both in product and production, stretch over into the fields of metallurgy, of chemistry, of physics, and demonstrate how necessary it is to widen the training of the future Production Engineer.

Let me give one more example of your future scope. At least $1\frac{3}{4}$ million people in this country are in transport, and when you tot up all the miles run by all goods trains, lorries and vans you realise why you are in so many traffic jams. Add for good measure the miles run (or walked) by internal trucks and you see the great possibilities of reducing transport costs. The work our Institution has done on Material Handling is pure production engineering, and if only every company would segregate its true cost of moving things about internally and externally, it might concentrate more production engineering on to the problem.

I have for years regarded reduction in handling a major job for the Production Engineer. Let me quote just one example of waste. A friend of mine is a sea captain and his pre-war time for a round trip to, say, Australia, was about $3\frac{1}{2}$ months. Today it is nearer 7 months. Just imagine the delays in delivery and the waste involved. Our present policy of restricted imports is reducing shipping activity considerably, and I for one am not alarmed. I believe the Production Engineer of the future must take even more drastic steps to reduce material transport, whether by ship, rail, road or shop floor. Movement adds cost, but not value to the product, and at our present rate moving costs are too high as percentage of total. Quite apart from economics, the strategic problems created in war by an extension to our present transport jams would be most serious.

You can do more than you at first think. Minimising imports, planning sub-contract facilities, improving handling facilities everywhere, making factory processes more self-contained by new processes —all add to efficiency by reducing transport. I could quote a few cases such as pressure die-casting, high frequency heating and precision casting where a process has been integrated into the production line with great saving in a variety of ways.

Then, of course, we shall have the ever-with-us problem of increasing the productive efficiency and

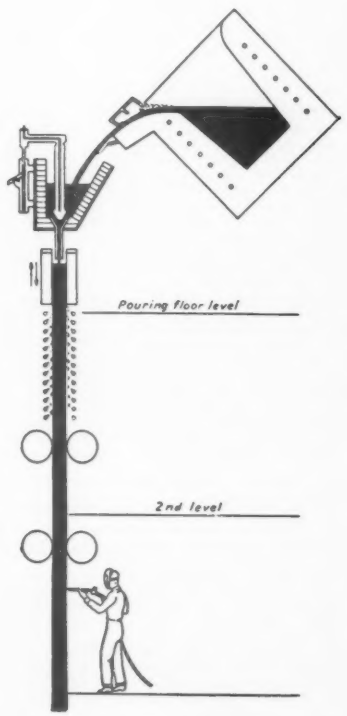
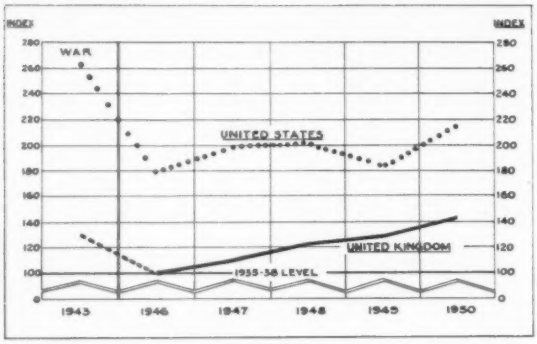


Fig. 12



INDEXES OF OUTPUT RELATIVE TO PRE-WAR

Fig. 13

happiness of all who work. Fig. 13 shows how we and the U.S.A. have tackled productivity since the War, but a satisfactory annual rate of increase in productivity calls for ever more ingenuity, sharpened by the fact that we shall have more mouths to fill than those who work to fill them (you will remember the U.S.A. figures I quoted earlier).

How can our Institution help the Future ?

So far I have covered in the briefest fashion those problems and techniques that will confront the Production Engineer of the future. Such a programme requires a strong representative Institution, which is able to sponsor such activities on a national scale, and to provide the standards of education and membership which will in turn produce enough trained practitioners. Your Council, its Principal Officers, and its staff, have spent much time in recent years planning the direction of our efforts; you and your fellow members have contributed greatly to the execution of those tasks. The result has been an almost spectacular growth in the Institution of Production Engineers, in the recognition of the value Production Engineers are to society and, on a more mundane but quite important level, in the rewards won by our members.

The rewards have been threefold. First of all there is the satisfaction which crowns that greater recognition by society of your efforts and your value. Without it no man, however financially rewarded, will give constantly of more than his normal. There is the second reward of added status in the job and you have only to look in the columns of the press to realise how many Production Engineers are now being promoted to higher posts in business and Government. How grand to find so many members who are daily refuting the oft-quoted statement that few engineers possess managerial vision !

Thirdly, the financial rewards have considerably increased, and reading our own Appointments Bulletin you realise the greater demand for Production Engineers and Managers, accompanied by salaries several times higher than pre-war.

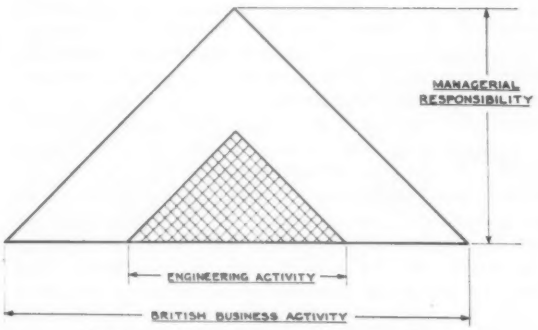
Council has, as you know, used the term " Broadening the Base " in its policy of expansion, and this has not been achieved by sitting down ! Fig. 14 shows diagrammatically what it involves.

Our Institution was founded on wise counsels, but we have not always lived up to that early standard. One of the original objectives was " to promote the science of *practical production in any branch of industry* . . . " Another objective was " to enable engineers, manufacturers and specialists who are *engaged in productive effort of any kind* to meet, discuss, correspond and generally to facilitate . . . the science and practice of manufacturing." Only the italics are my own; the breadth of vision belongs to the pioneers of 30 years ago, when Production Engineers could rarely be seen, let alone recognised.

You will notice the scope envisaged by the pioneers. No mention is made of the engineering or metal-working industries only as one field of endeavour. The whole of industry is our legitimate territory. Yet during the first decade or two our activities, and our membership, were confined very largely to the metal-working industries. We were, indeed, for a while assumed to be engineers working almost solely within the machine tool sections of engineering. Within the last few years, however, we have rediscovered our birthright, and have made many successful attempts to broaden our base so that our scope, our value, our contributions and our membership include many other industries and activities.

Now when you increase the base of a triangle and maintain its angular shape you increase the height. In our objective, height is defined as managerial responsibility and, putting it briefly, the greater our spread the higher our managerial status. The greater the field of endeavour, the greater the recognition and quality of membership.

Our Institution has now over 9,000 members, an impressive total of men ranging from the student immersed in his production training to the Managing Director immersed in his many problems. Engineering employs about 3½ million people, or about 16% of the total civil employment. Go back again to Figs. 1 and 2 and realise how much we rely on the engineering group which accounts for 36% of our total exports. Perhaps it is a coincidence that 32% of our Corporate Members are employed in



" BROADENING OUR BASE "

Fig. 14

engineering activities, and one might well claim that the greater recognition of production engineering techniques has helped the industry to do so well.

Even so, let us reflect soberly on the fact that less than 4,000 members in engineering spread very thinly indeed over 3½ million workers. What a future educational job for managers and colleges and institutions !

A gratifying feature of recent advertisements has been the higher percentage of vacancies for Production Engineers wanted by other industries, and many of you know the difficulty of finding such men, because with the heavy demands on engineering every trained man is wanted in that industry.

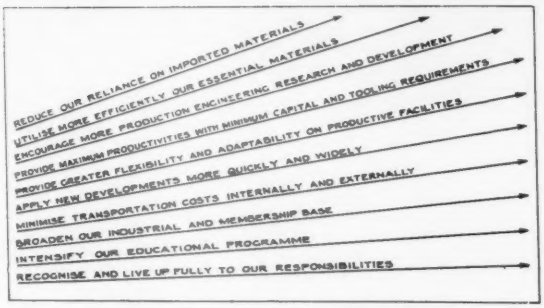
Education

When you embark on one programme you invariably find that related problems arise and need attention. Broadening the base was no exception, and it brought with it the very real problem of broadening and raising our educational and membership standards. For instance, it does little good to insist on jig and tool design for someone in the chemical industry; it is no good talking of higher status without higher standards of entry. I won't pretend that we are inside the outer fringe of these developments.

One fundamental requirement is that we still remain engineers with basic engineering training, and by this I don't necessarily mean production, mechanical, electrical or any other type of engineering. There is plenty of common content in all such specialist activities.

The next fundamental requirement is that we, of all Institutions, must never raise our brows to the level where we lose sight of the factory floor. In the last analysis everything must be made if it is to be of use and we, as Production Engineers, must provide that essential link between conception and realisation—between designer and factory worker.

Let us look for a moment at the political scene. Here we find the nation just about equally balanced between one side or the other for years to come. This is bound to produce unstable political and industrial conditions which may become apparent shortly in both steel and transport. It is our job, as people in close touch with the shop floor, to increase productivity in the midst of these difficulties. No easy task, and only accomplished by great technical skill and personal status.


REDUCE OUR RELIANCE ON IMPORTED MATERIALS
UTILISE MORE EFFICIENTLY OUR ESSENTIAL MATERIALS
ENCOURAGE MORE PRODUCTION ENGINEERING RESEARCH AND DEVELOPMENT
PROVIDE MAXIMUM PRODUCTIVITIES WITH MINIMUM CAPITAL AND TOOLING REQUIREMENTS
PROVIDE GREATER FLEXIBILITY AND ADAPTABILITY ON PRODUCTIVE FACILITIES
APPLY NEW DEVELOPMENTS MORE QUICKLY AND WIDELY
MINIMISE TRANSPORTATION COSTS INTERNALLY AND EXTERNALLY
BROADEN OUR INDUSTRIAL AND MEMBERSHIP BASE
INTENSIFY OUR EDUCATIONAL PROGRAMME
RECOGNISE AND LIVE UP FULLY TO OUR RESPONSIBILITIES

SOME OF OUR FUTURE PROBLEMS

Fig. 15

I said earlier that farming, for instance, will inevitably become more intensive and more mechanised. A further spread of industrial techniques into farming may well bring a further spread of industrial difficulties and outlook, upsetting as I said earlier the present precarious balance of political and social forces. Our effectiveness as man-managers as well as engineers may alter profoundly the wider scene of British life. Our techniques of production generally will have to be more flexible and this may mean greater variations in personal earnings. New techniques may have to be introduced more frequently, again calling for dislocation to layouts and men's jobs. These trends will mean greater difficulty on the shop floor than in the office, yet the Production Engineer has one foot in each. He must remember that no design is worth while until it works; no policy is sound until it becomes performance; he is, if I may coin a phrase, a doctor attending to the birth of the third dimension !

What do you think of our future ? Does it frighten or appeal to the younger members in my audience ? Does it encourage the fathers present to show the possibilities to their sons ? I will leave you to answer in your own way, but for myself, having spent at least 25 happy years as a Production Engineer, I look forward to the next 25 with a great deal more excitement. Let us get together again in 1977 to compare notes ! In the meantime, take a look at some of our problems collected together in Fig. 15.

Never, as Mr. Churchill didn't quite say, have so many problems chased so few Production Engineers!

APPENDIX

United States Information Service

EXCERPTS FROM REPORT OF THE PRESIDENT'S MATERIALS POLICY COMMISSION

There is a materials problem of considerable severity affecting the United States and the industrialised nations of Western Europe. Unless the problem is effectively met, the long range security and economic growth of this and other free nations will be seriously impaired. The Commission's report is primarily concerned with the United States' problem, which cannot, however, be isolated from the rest of the free world problem.

The basic reason for the problem is soaring demand. This country took out of the ground two and a half times more bituminous coal in 1950 than in 1900; three times more copper, four times more zinc, 30 times more crude oil. The quantity of most metals and mineral fuels used in the United States since the First World War exceeds the total used throughout the entire world in all of history preceding 1914. Although almost all materials are in heavily increasing demand, the hard core of the materials problem is minerals.

In the 1950's, the United States consumed 2,700,000,000 tons of material of all kinds—metallic ores, non-metallic minerals, agricultural materials, construction materials, and fuel—or about 36,000 pounds for every man, woman and child in the country. With less than 10 per cent. of free world population, and only 8 per cent. of its area, the United States consumed more than half of 1950's supply of such fundamental materials as petroleum, rubber, iron ore, manganese and zinc.

The Materials Policy Commission was asked by President Truman to investigate the long-term aspects of the materials, as the period for study the quarter of a century between 1950 and 1975. The Commission's Report does not overlook the possibility of war in this period but neither does it assume war. War would alter the patterns. If peace should prevail, and all the nations of the world should acquire the same standard of living as our own, the resulting world need for materials would be six times the present consumption. In considering materials at long range, therefore, we have roughly the same problems to face and actions to pursue, war or no war.

.....

Rising Costs Chief Threat

Absolute shortages are not the threat in the materials problem. We need not expect we will some day wake up to discover we have run out of materials and that economic activity has come to an end. The threat of the materials problem lies in insidiously rising costs which can undermine our rising standard of living, impair the dynamic quality of American capitalism, and weaken the economic foundations of national security. These costs are not just dollar costs, but what economists refer to as real costs—meaning the hours of human work and the amounts of capital required to bring a pound of industrial material or a unit of energy into useful form. Over most of the 20th Century these real costs of materials have been declining, and this decline has helped our living standards to rise. But there is now reason to suspect that this decline has been slowed down, that in some cases it has been stopped, and in others reversed. The central challenge of the materials problem is therefore to meet our expanding demands with expanding supplies while averting a rise in real costs per unit.

In materials, there is always a tendency for real costs to rise because invariably people use their richest resources first and turn to the leaner supplies only when they have to. What is of concern today is that the combination of soaring demand and shrinking resources creates a set of upward cost pressures much more difficult to overcome than any in the past. In the United States there are no longer large mineral deposits in the West waiting to be stumbled upon and scooped up with picks and shovels; nor are there any longer vast forest tracts to be discovered. We can always scratch harder and harder for materials, but declining or even lagging productivity in the raw materials industries will rob economic gains made elsewhere. The ailment of rising real costs is all the more serious because it does not give dramatic warning of its onset; it creeps upon its victim so slowly that it is hard to tell when the attack began . . . .

The Commission's Report discusses at length the ways and means whereby rising real costs can be halted, and a trend towards lower real costs, such as we enjoyed through most of the first half of the 20th century, re-established. It also recognises the problem of having enough materials available in the event of war, and considers various ways of assuring a security of materials. The Report emphasises that "there is no such thing as a purely domestic policy towards materials that all the world must have; there are only world policies that have domestic aspects." The Commission states its conviction that if the United States and other free nations are, in the years ahead, to enjoy economic growth and national security, "they must co-ordinate their resources to the ends of common growth, common safety and common welfare." The Commission states as the major premise of its Report that:

"The overall objective of a national materials policy for the United States should be to ensure an adequate and dependable flow of materials at the lowest cost consistent with national security and with the welfare of friendly nations" . . . .

Uneven Demand Foreseen

Demand for materials will rise most unevenly, sometimes increasing one-quarter or less, sometimes rising four-fold or more. Among the major classifications, something like this might be expected in the United States (1975 compared to 1950):

Demand for minerals as a whole, including metals, fuels, and non-metallics, will rise most—about 90 per cent. (more), or almost double.

Demand for timber will rise least—about 10 per cent.

Demand for all agricultural products will rise somewhere in between—about 40 per cent.

In addition to the above:

Demand for energy in all forms will double.

Demand for industrial water will increase roughly 170 per cent.

Taking these classifications one by one shows wide ranges and various problems within each. There can be plenty of room for argument as to how high the demand for this or that will really rise, but the central fact is: the demand for everything can be expected to rise substantially. These projections, which look high today, may look low tomorrow.

The above figures apply to the United States alone. For the rest of the free world the projections made by the Commission are necessarily much rougher, but they suggest that *demand in other free nations, building as it will on a smaller base, will be even larger in its percentage increase than the U.S. demand,* and that the United States, although its total of materials consumption will increase greatly, will probably consume a somewhat smaller share of the free world's total supply.

.....

Three Major Paths

In general the United States has three major paths to follow in working out the problems of high consumption, prudent conserving, and a domestic resource base that is shrinking in comparison with our needs:

(1) We can make new discoveries of needed materials at home, and otherwise increase the useable fraction of our total resource base.

(2) We can alter our patterns of use away from scarce resources and towards more abundant ones.

(3) We can import larger quantities of materials from other nations of the free world on terms advantageous to buyer and seller.

Increasing Useable Domestic Base

A means of increasing the useable fraction of the domestic resource base consists of more efficient extraction. We still leave about half of the commercial grades of coal behind in the ground after mining, and more than half the petroleum in the average pool. Enough natural gas was wasted in 1950 to supply the gas needs of 11,000,000 of the nation's homes. Only 65 per cent. of the average tree that is cut ends up as useful material. We must find out how to use lower and lower quality resources, and weaker and weaker concentrations of materials . . .

Getting More from Imports

The Commission rejects completely the concept of United States "self-sufficiency" as amounting to "nothing more than a self-imposed blockade." The Report continues: "The fact that nature distributed resources very unevenly over the face of the earth in relation to human population and consumption alone argues in favour of increasing integration of the various national economies of the free world. But the hard political facts of mid-Twentieth Century add further great weight to the proposition that it will be to the mutual advantage of all freedom-loving people of the earth to achieve a greater measure of economic and political co-operation than ever before, founded on the principles of mutual help and respect. Such co-operation can succeed only if it is based on a clear understanding of the varying needs and resources of all the nations concerned, and the opportunities which lie in mobilising the strength of all to meet the particular weaknesses of each."

.....

THE EXTRUSION OF BRASS ROD AND SECTION

by D. J. BROADLEY, A.M.T.C.

Presented to the Melbourne Section of the Institution in June, 1951 *and to the Adelaide Section in April,* 1952.

Mr. Broadley, who is Chief Metallurgist of the Ogden Industries, Metalex, Australian Die Castings Pty. Ltd., Group of Companies, received his technical education at Junior and Senior Technical College, and qualified for an Associateship Diploma of Secondary Metallurgy at Melbourne Technical College in 1947.

He has been engaged in the extrusion industry since 1941, and joined the Metalex, Ogden Industries and Australian Die Castings Group in 1949, as Plant Metallurgist.

THE process of the extrusion of metal sections has been most conveniently described as the application of pressure to a billet enclosed in a cylinder until plastic flow commences, the deformed metal then being forced from the cylinder through an orifice shaped to the profile of the desired section.

The Work of G. A. Dick

The engineering industry and, in particular, the repetition field, is indebted to George Alexander Dick for his energy and foresight, in extending the field of extrusion to what can be conveniently termed "the hard metals". Dick, born in Germany, of English and Scottish descent, was successively an Analytical Chemist in a German iron works; Blast Furnace Manager in Spain; and part-proprietor of a general engineering business in Paris.

After the Franco-German war of 1870, when he settled in England, he, with others, founded the Phosphor Bronze Company of London, which he managed until 1881. For some years, Dick studied copper and copper base alloys, and began the manufacture of the Delta series of alloys, converting his business in 1888 into the Delta Metal Company Limited. After studying the *flow* of copper alloys in the production of stampings and pressings, he became interested in the idea of making rods, tubes and sections by a process cheaper than rolling and drawing and, after preliminary experiments in a small vertical hydraulic press, was eventually successful, in 1894, in extruding certain brasses and other copper alloys. He commenced manufacture by the process in London, and later in Birmingham and Dusseldorf.

Records exist of several efforts to do this during last century, but the difficulties at first proved too great. One report surprisingly states: "It was anxiously and unexpectedly found that when the brass block was subjected to pressure, the zinc left the copper, thereby producing a zinc pipe and leaving the copper behind, proving that the atoms of brass composition united by fusion were only mechanically arranged, not chemically combined".

Dick continued to make notable contributions to this field of extrusion until his death in 1903.

Continuous Progress

Progress in extrusion techniques has been continuous, and today the process is eminent amongst the non-ferrous production methods. Dick must be credited with many of the features of today's techniques. He initiated progress in tube manufacture by experiments with various types of fixed and floating mandrels. He suggested the use of a hollow ram for inverted extrusion and the use of an electrically heated container. The modern extrusion press for hard metals embodies most of the principles discovered by Dick, and in 1894 he claimed that the

method was applicable to the following range of alloys :—

	Cu	Zn	Fe	Al
1	58	40	2	—
2	85	10	—	5
3	90	—	—	10
4	60	40	—	—

Fig. 1.

The merit of Dick's achievements cannot be over-emphasised. The development of this method for the fabrication of non-ferrous metals and alloys, involving the operation of some press components under high pressure and in contact with billets at temperatures above 600°C. for considerable periods, was carried out at a time when the development of heat-resisting steels was in its infancy. He also lacked the assistance of developments we tend to take for granted today, such as progress in pyrometry and hydraulics.

Press Construction

The extrusion of brass rod and section is most usually carried out in hydraulically-powered horizontal presses. High pressure water for the operation may be obtained by direct coupling to high pressure pumps or, alternatively, drawn from an air-water accumulator system. The capacity of the press, usually quoted as the total ram pressure, may vary between 500 and 1,500 tons and the choice of press capacity depends, for brass, on the range of production for which it is intended.

Fig. 2 shows a press of modern design, intended for fairly universal application. It is primarily intended for the production of brass rod and section; but it is also adaptable to the extrusion of alloys found more difficult to extrude, such as aluminium bronze, duralumin, cupro-nickel, silicon bronze, copper and cartridge brass. The press is fitted with independently-operated piercing equipment for the production of tubes and other hollow shapes in these alloys. The capacity of this press is 1,000 tons, and it is of what may be regarded as standard design. Three stout columns connect the main ram and die block housings.

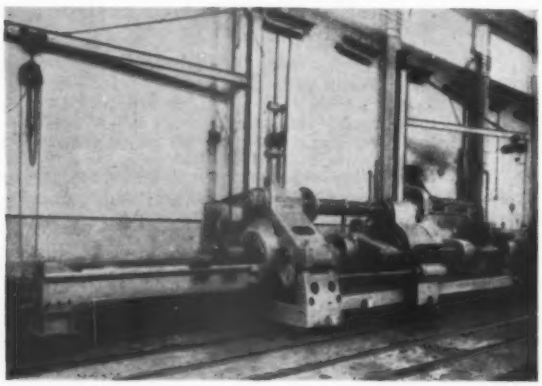


Fig. 2

The billet container holder slides on independent supports; it is withdrawn over the ram to allow the insertion of the billet prior to pressing, and is actuated by auxiliary side hydraulic cylinders. A die-head locking wedge operates within the die block housing, locking the die-head against the container rim during extrusion.

Direct Extrusion

To indicate more clearly the press arrangements for direct extrusion, Fig. 3 is a cross-sectional diagram of the effective zone of the press with the various components in position for extrusion :

(1) represents the container housing,
(2) the extrusion ram, and
(3) a pressure disc or follower pad.

The space (e) would be filled by the billet.

The follower pad (3) encloses one end of the container.

The die (a) fitting into die holder (b), which is centred by a conical seating in the container, encloses the other end of the billet, thus preventing escape of the metal. The die holder is supported by bolster (c), which fits into the die-head (d), the whole die assembly being locked in position by locking plate (5).

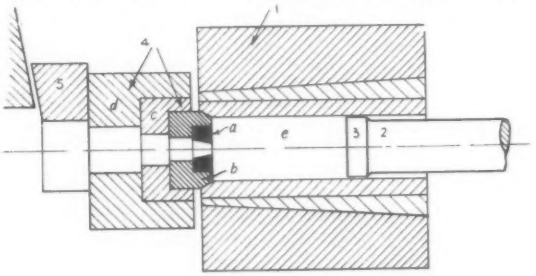


Fig. 3

The sequence of operations for direct extrusion is shown in Fig. 4. With the ram in the retracted position as shown in (a), a hot billet is brought to the cradle in front of the container, and (b) is pushed in by the ram, working for this and for other idle strokes on a low-pressure storage cylinder. The pressure disc (c) having been inserted, the ram is advanced to upset and then extrude the billet, the latter being effected under pressure from the accumulator or, in the case of a direct coupled unit, from the high pressure pump. The billet is never completely extruded. Even were it desirable to do this, it is impossible to exert sufficient pressure to eliminate the thin final disc. As will be seen later, the press is stopped in practice for other reasons when a short stub of the billet, referred to as the discard, remains in the container. At (d) the wedge, or locking plate, having been raised, the ram is advanced further to push out the discard and is then retracted. By means of hydraulic reciprocating gear attached to the die-head, it is moved clear of the press-head to a position where a pair of shears, or a motor-driven circular saw swinging in on an arm, severs the extruded length from the discard close behind the die. The die-head (e) is now moved back against a small

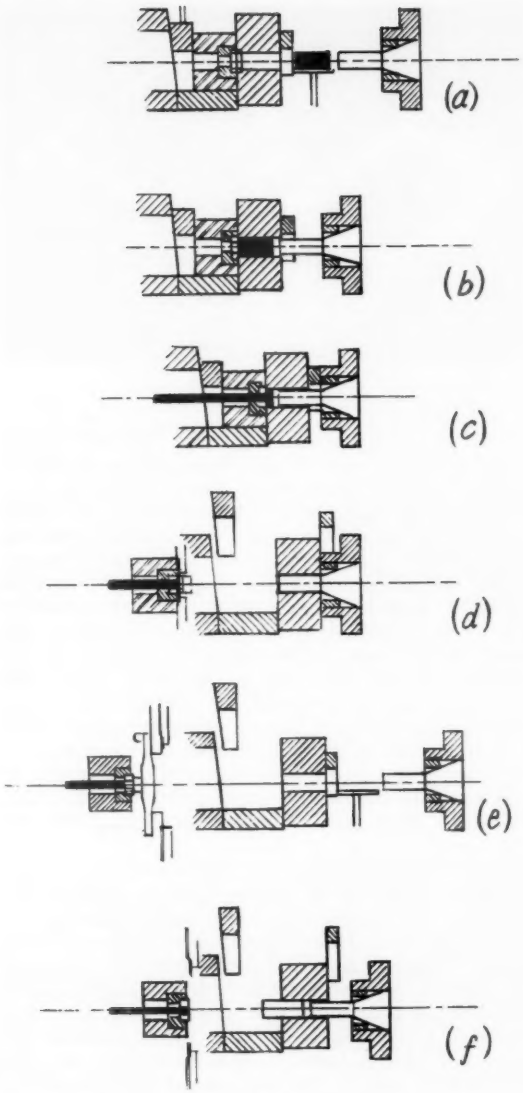


Fig. 4

ejection mandrel swung in to dislodge the end of the extruded bar from the die, allowing it to be passed down the runway to the cooling bench to be roughly straightened by hand while it is still hot. The final step (f) is to dislodge the thin sleeve or shell of metal which is, in most forms of practice, left on the wall of the container as the result of the clearance purposely provided between the pressure disc and the container. The sleeve may come away with the discard, or it may, as shown, have to be ejected, using a close-fitting clearing disc, by a further stroke.

Tube Extrusion

Before leaving consideration of this modern press, it may be of interest to digress briefly from the scope of the title of this Paper and include some discussion of the attachments necessary for the extrusion of tubes and hollow shapes.

Tubes can obviously be produced by extrusion if a mandrel around which the metal must flow be retained in the die aperture during extrusion. Various means to achieve this end have been used.

A fixed mandrel screwed to the extrusion ram and moving with it during extrusion, was first attempted, but amongst other disadvantages, the mandrel could not be prevented from unscrewing. To overcome this, the floating mandrel was evolved, but again demanded the use of hollow cast billets. To achieve concentricity in the tube, deflection of the mandrel from its central position in the billet, while the preliminary operation of upsetting was taking place, posed additional problems.

Finally, the independently actuated piercing mandrel was developed, the sequence of operations then being to upset the billet to fill the container completely with the mandrel withdrawn. (Fig. 5). The piercing mandrel which operates through and co-axially with the extrusion ram, but independently of it is next advanced to push the central slug from the billets and just to enter the die aperture. Extrusion then proceeds as for solid sections, the mandrel either held stationary in the die aperture or possibly advanced at a slower rate than the extrusion ram.

The rate of mandrel movement is dictated by the frictional qualities of the metal being extruded.

The sequence of operations in the production of tubes by direct extrusion is illustrated in Fig. 6. In (a), with the mandrel withdrawn, the extrusion

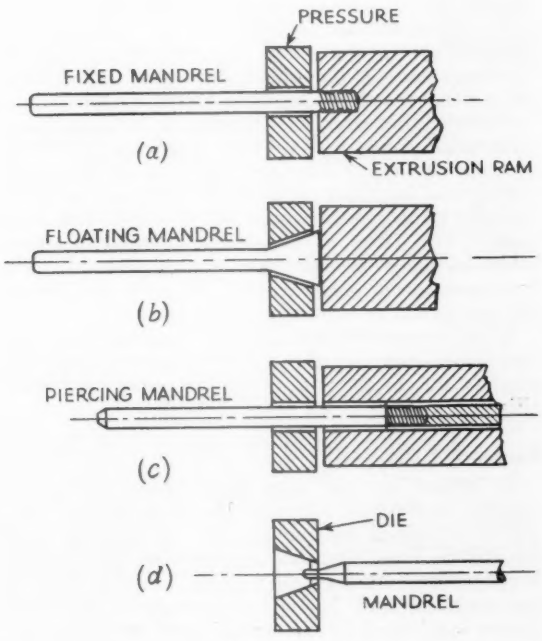


Fig. 5

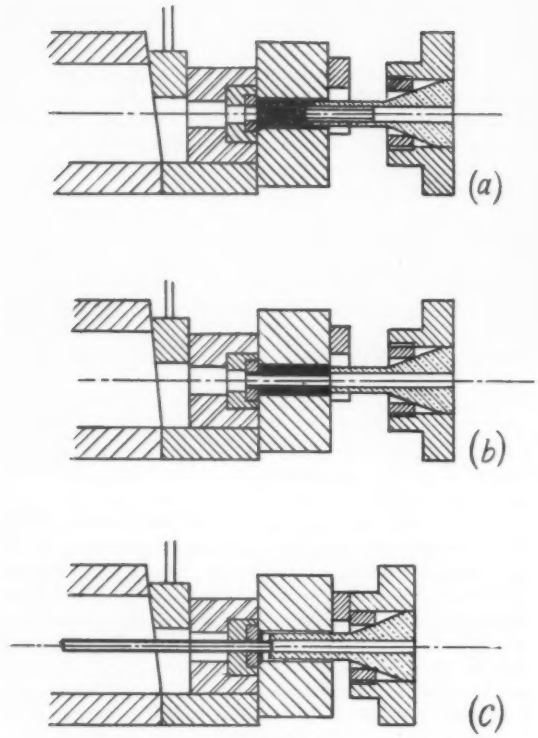


Fig. 6

ram has advanced to upset the billet. In (b), the mandrel, operating as a piercer, has been pushed through the centre of the billet, extruding a solid slug of metal. In (c), the tip of the piercing mandrel, now in the centre of the die, has permitted the extrusion of the billet into tube and a thin discard disc remains to be severed from the tube.

The mandrel operating cylinder is mounted in a yoke which is connected to the main ram cylinder by two columns. The piercing ram is supported throughout its length of movement by a cross-head running on two small wheels on the rigid press bed-plate. This latter is one of the many refinements added to presses intended for the production of tubes to ensure correct alignment of the press, and hence aid the production of concentric tubes.

Since a controlled rate of the movement of the mandrel is possible, the use of a tapered mandrel permits the production of hollow tapered shapes. (Fig. 7).

Indirect Extrusion

In almost all lead pipe presses the inverted or indirect method of extrusion has been in use since 1870. A design embodying this method was put forward by Dick, who patented the idea of extruding simultaneously through dies placed at both ends of the container and, in 1893, a premature American patent was lodged for the extrusion of steel billets by the indirect method.

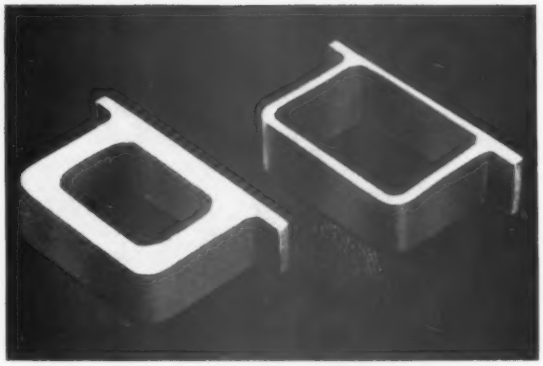


Fig 7

The practical application of the indirect method to the extrusion of brass and other hard metals lapsed until after 1926, when it was shown by Genders that owing to the manner in which flow of the metal occurred in this process, the well-known extrusion defect found in material made by direct extrusion could be avoided and, moreover, lower extrusion pressures were required. With indirect extrusion, the metal is caused to flow progressively from the front of the billet. The billet is enclosed in the container at the rear end, by the main ram. The extruding ram is replaced by a long hollow die holder or die stand. The die stand projecting back from the front of the press carries the die assembly. Advancing the main ram causes the container to pass over the hollow die stand and forces the billet to extrude from the leading surface through the die aperture.

Fig. 8 shows a Krupp press of unorthodox design which is adaptable to either direct or indirect extrusion. The massive cast steel yoke frame, within which the normal die assembly for direct extrusion can be locked or to which the long hollow die stand for indirect extrusion can be fitted, encloses a container capable of movement over an unusually long stroke. For extrusion by the direct method, an extrusion ram is fitted to the main ram and, for the inverted process, the main ram is used to enclose the rear end of the container.

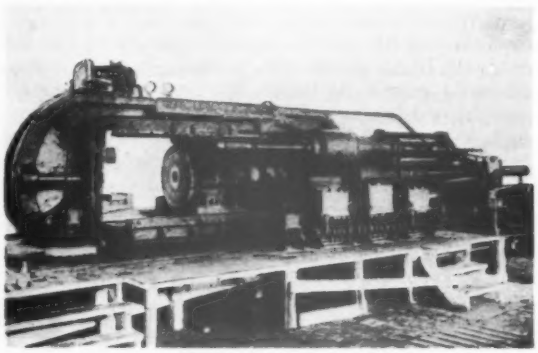


Fig. 8

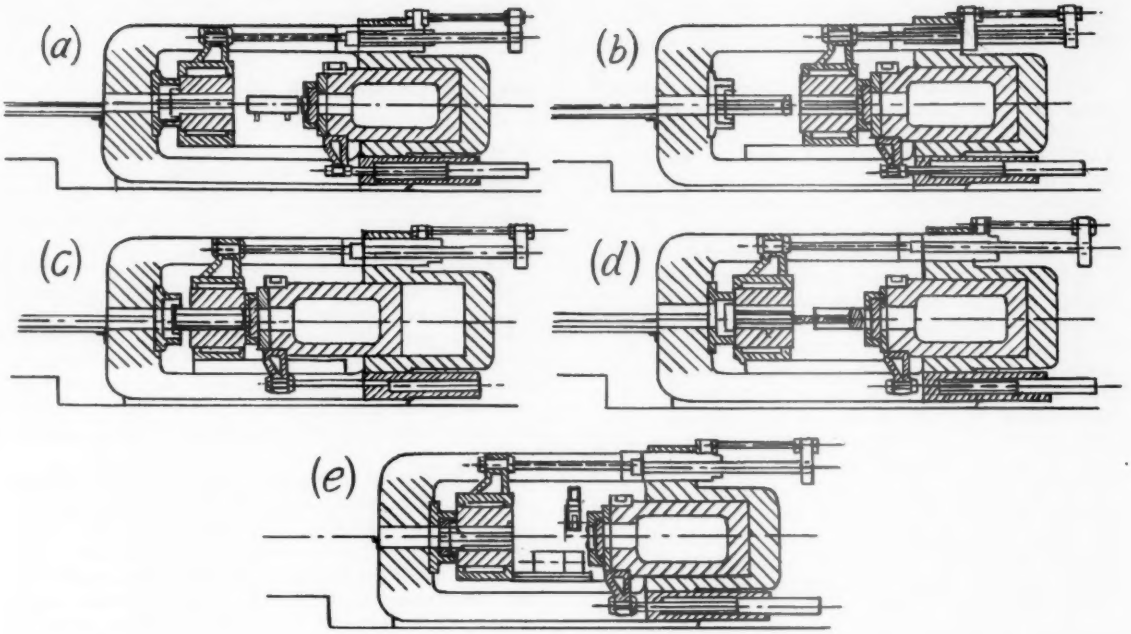


Fig. 9

Conventional arrangement of hollow die stand for indirect extrusion.

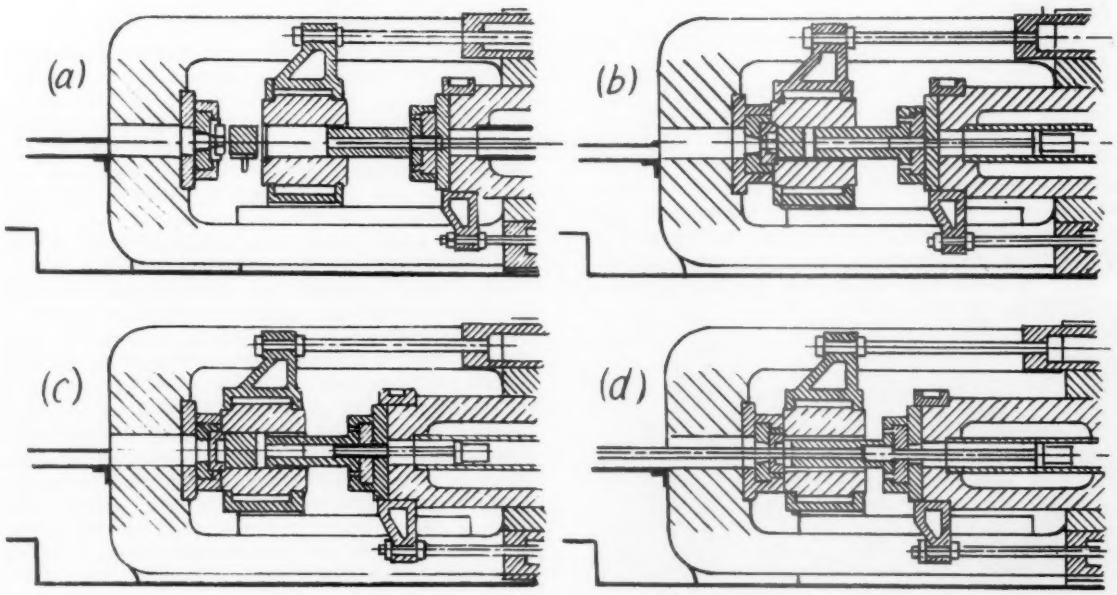


Fig. 10

Operation of the same press for both direct extrusion and piercing for tube production.

In Fig. 9, (b) best illustrates the conventional arrangement of the hollow die stand for indirect extrusion. The die assembly can be seen mounted in the rear end of the die stand.

In (a), the container has been moved over the die stand and the billet inserted; in (b), the container is returned to extruding position over the billet. The die assembly is in place in the die stand. In (c), with the exfrusion in progress, the main ram has advanced and pushes the container over the die stand forcing the billet to extrude through the die. At the completion of extrusion, (d), with the container covering the die stand, the main ram has been withdrawn, the residue after extrusion, or what, in mill parlance, is termed " the butt and shell ", has been withdrawn with the main ram, and (e) depicts a pendulum saw swinging back into the rest position, after having severed the butt and shell from the back end of the rod. It should be noted here that, while in the case of direct extrusion the extruding ram is forced through the billet and the metal extruded through the stationary die, in this, the inverted method, the die has been forced through the billet. The major disadvantage suffered by the indirect method is that extrusions are limited in size by the internal diameter of the die stand.

Fig. 10 serves a dual function in showing the operation of the same press for both direct extrusion and piercing for tube production.

Both the direct and inverted methods are employed in what are usually smaller and faster presses for vertical extrusion. Production from these presses is usually limited to tubes, but some more intricate sections may be manufactured by this means.

Die Assembly

The most usual method of die construction for both types of extrusion is to mount a die plate in a die holder and support these by a bolster, which is then carried by the die-head (Fig. 11). Alternatively, the bolster construction may be incorporated in the design of the die-head, some of the reasons for this complex construction being :

(1) the cost of the accurately finished die plate is dependent on the thickness of the plate;

(2) the die plate must be adequately supported to resist the considerable pressure applied to the die face;

(3) the die holder and bolster can frequently be designed to serve a number of similarly shaped dies.

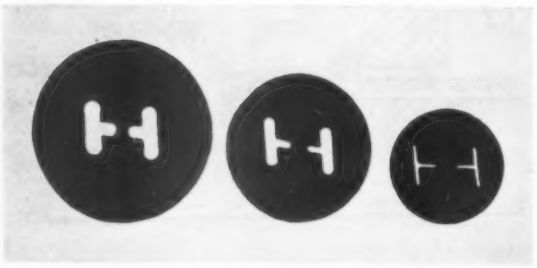


Fig. 11

Die and Container Steels

The high pressure, high temperature conditions demand special properties from the steels used for container liners, the die assembly and follower pads. A tungsten-chrome-vanadium hot die steel (10% W 2.5% Cr 0.3% Va) is usually used for the die.

Tungsten carbide extrusion die inserts have been used with some success and are particularly noted for ability to hold size. They do, however, spall at the inlet and also tend to fail by a radial crack, probably due to the repeated rapid change in temperature and differences in expansion rate, between the steel die plate and tungsten carbide insert. Stellite and stellite-faced dies have also been used at various times.

The die-holder, die-bolster, die head and follower pads may all be made in a high tensile nickel-chrome-molybdenum steel (Ni 2.5% Cr 0.5% Mo 0.6%) which performs most satisfactorily in service. This steel has adequate resistance to movement under the hot compressive conditions for most extrusion application other than dies. Of course, other types of heat resistant steels have been tried and are used, but general practice accords with our experience in this selection.

Liners are most frequently forged in a similar nickel-chrome-molybdenum steel which, where pressure is not excessive and the extrusion rate reasonably rapid, gives most satisfactory service.

Hydraulic Operation of Presses

Whilst on the Continent and in England, the operation of presses from pressure accumulators is preferred, rod presses in the U.S.A. are frequently driven directly to the pumps. In Australia, both methods of press operation are used. Both vertical and horizontal pumps of the three-throw type are employed, and when directly coupled to the press may deliver up to 150 gallons per minute of high pressure water. An accumulator system permits operation from a lower capacity pump operating continuously, to replace the energy drawn from the accumulator for the spasmodic pressing operation. Accumulators also permit infinite control of press speed. This is a most desirable feature in the production of intricate shapes and the extrusion of special alloys. The two general types of accumulators are the dead weight and air-loaded or pneumatic. The former type is the comparatively simple arrangement of a vertical steel cylinder containing water, loaded by a piston supporting a dead weight. The *area* of the cylinder and the dead weight are so related to provide the required pressure and volume of water.

The disadvantages of this type of accumulator are the heavy foundations required to carry it and the severe pressure surges incurred in its operation, due to the release of the kinetic energy of the heavy moving

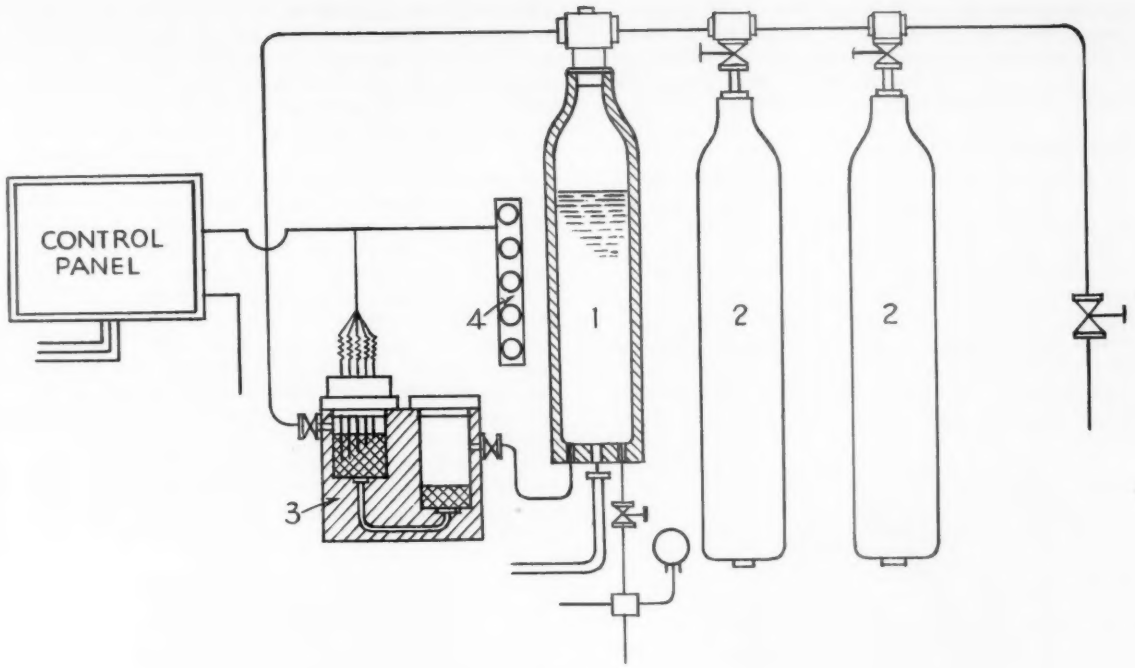


Fig. 12

mass when the withdrawal is suddenly interrupted, endangering the pipeline and valve gear.

The pneumatic type accumulator is so arranged that the pumps deliver to a forged steel water bottle, pressure water which maintains air compressed in auxiliary bottles to the desired pressure. A mercury manometer connected to the base of the steel water bottle operates a series of electric contacts which control the admission of pressure water from the pumps to the pressure water bottle, and so control control the pressure accumulated. (Fig. 12).

A large accumulator installation, of the type just discussed, is shown in Fig. 13.

Billet Heating

Many of the limitations earlier suffered by the extrusion process were conferred by the difficulty in maintaining uniform heating throughout the billet, and constant temperature in what really is a continuous flow of metal of considerable volume to the press.

Billet heating furnaces of modern design successfully fulfil these requirements and may be oil or powdered coal-fired, or heated by cross-fired producer gas. There are only rare instances of the use of electrical heating for brass extrusion. The furnaces usually employed are of an inclined hearth gravity feed type.

Taking advantage of the invariably circular cross-section of the billet a continuous flow through this type of furnace can be obtained. The discharge and charging doors are frequently so arranged that as a heated billet is withdrawn, the billets in the furnace roll down the hearth and a cold billet is charged automatically into the furnace through the entrance door. Mechanical elevating equipment is usually provided at the charging end to raise the billet to hearth level.

The discharge of the heated billets and delivery to the pressing position is, in some cases, a mechanical operation controlled by the press driver, or may be an operation performed manually by the furnaceman.

We have now discussed most of the essential equipment and the sequences involved for both direct and indirect extrusion of brass rod and section. Briefly, to retrace and perhaps further clarify the picture, extrusion billets rolled through an inclined hearth furnace are delivered at a suitable temperature to a press, and charged into the press container. Pressure is applied to the billet enclosed in the billet

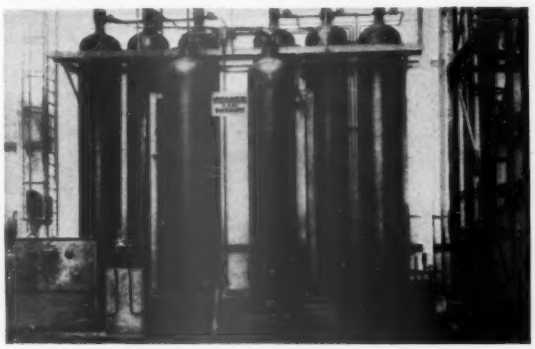


Fig. 13

container, forcing the metal to flow in the required shape through the die aperture. The press is operated from a control station and the high pressure water for its operation may be drawn directly from a pumping unit or *via* a pressure accumulator system.

Flow During Extrusion

The course of metal flow on extrusion first received serious attention during the 1914 - 1918 War, and research on this subject is still continuing.

Given sound billets free from every type of casting defect, defect in the rod may still arise during extrusion, due either to the enfolding of the billet skin and its inclusion in the rod, or an effect peculiar to the latter stages of pressing by direct extrusion when the tendency of the metal to flow from the outer areas of the billet assists the formation of a central pipe (Fig. 14). The former defect is almost

Fig. 14

completely reduced by the use of billets fitted neatly into the container and by the provision of sufficient clearance between the follower pad and the container to leave a shell after extrusion, containing the oxidised surface of the billet. The tendency towards piping can be reduced by incompletely extruding the billet and discarding the residue or butt. This may amount to a discard of up to 30% of the original billet weight, and the more generally accepted practice is to extrude as completely as pressure considerations will permit, and discard successively unsound portions of the back end of the rod as revealed by examination of a fractured cross-section.

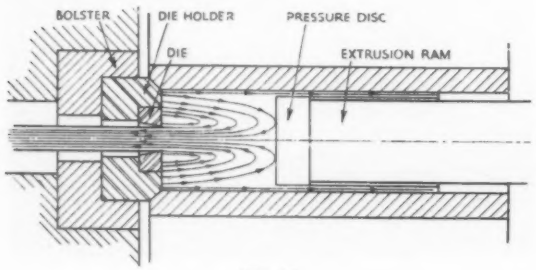


Fig. 15

Flow in Direct Extrusion

The best distinction between the flow conditions that obtain respectively in the direct and indirect methods, can be served by considering Fig. 15, which which is intended to represent the flow at a three-quarter extruded condition of a direct extruded billet. Flow to this stage can be considered to have followed a streamlined path similar to that illustrated later for indirect extrusion. At the three-quarter extruded stage, a stagnant zone which has been accumulating behind the die shoulders is forced to replace the metal drawn from the centre of the billet and does this following a semi-circular path, first in the direction of the follower pad.

Oxide or dross accumulations which form in pockets due to the crumpling of the surface skin during upsetting and advance just ahead of the follower pad, are swept into the rod by this stream and hence form the piping.

An etched butt illustrates piping entering the back end of an extruded bar. The cross-section of the back end of the fuse rod with a loose core, the result of piping, is also shown (Fig. 16).

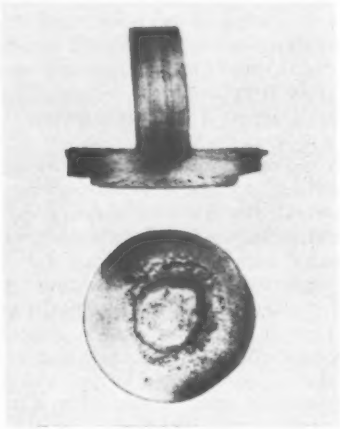


Fig. 16

Flow in Indirect Extrusion

With the pressure applied at the extrusion face of the billet and not transmitted through the billet, flow in indirect extrusion tends to follow a streamlined path. (Fig. 17).

Flow is confined to the zone adjacent to the die face, and is progressive from this zone throughout

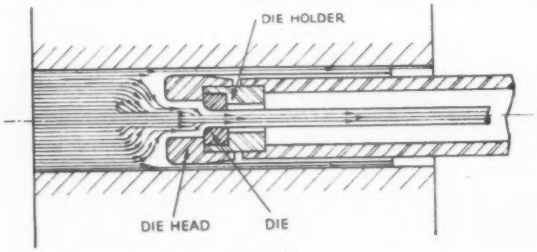


Fig. 17

extrusion. Oxide or dross pockets are contained either in the shell cut by the die head, or in the butt that pressure considerations prevent extruding. Hence, by this method, piping is eliminated and, moreover, inadvertent inclusions will appear on the skin of the rod and be readily detected by factory inspection.

Some rather ingenious ideas have been used in the investigation of flow phenomena. Etching and examination of sectioned, partly extruded billets have provided much information. However, much more has been learned by the use of composite billets. Composite billets built up of alternate brass discs of different composition with different etching characteristics have been partially extruded, sectioned, etched and examined.

Alternate concentric cylinders of magnesium, and zinc magnesium alloy, built up to form a solid billet have also been used, and a number of instances are recorded of the use of layered billets of coloured wax, Plasticine and other organic materials. The most ingenious method used has been to section longitudinally, into two equal halves, ordinary cast brass billets. A net or similar pattern is inscribed on one or both of the cut faces. A preparation to prevent welding during extrusion is rubbed on the faces and the two halves are then put together and secured, during pre-heating, by bands which can be removed when the billet is placed in the billet container. After partial extrusion, the rod and the residue can be readily split along the prepared faces and the progress of flow is indicated by the distortion of the inscribed pattern.

Preparation of Dies

The preparation of dies for extrusion is a highly technical job calling for skill and experience that varies according to their intricacy. That such a multitude of sections as is now available to meet the needs of engineers and others can be produced, is attributable in no small degree to the resourcefulness of the die-maker. He has many things to take into account, such as the special characteristics of the metal to be extruded, allowances for stress and distortion and the thermal contraction of the extruded section after leaving the die. Precautions must also be taken to ensure a well-balanced flow of the metal into all parts of the die. The rate of flow of all parts of a regular section is similar, and no special problems in this respect arise, but with irregularly shaped sections, the resistance to flow is lowest in the widest parts, and highest where the section is narrow, or in the vicinity of sharp corners. If no special precautions are taken when a die is made for, say, a special channel section in which narrow flanges and a wider base are required, a useless crumpled extrusion will result.

The extrusion die-maker, with a facility born of experience, controls the rate of flow in the different portions of such a die by extending the land in the wider sections and reducing it at the corners and narrow sections, to choke and encourage flow as necessary to produce satisfactory sections. The attainment of satisfactory flow from the die in sections of complex shape, simultaneously from two or possibly three apertures when the area of the section is small, calls for skill of no mean degree. Full credit must be given to the die-maker in this, as in so many other industries, for the success which has accompanied his efforts.

Multiple-hole dies are often used in extruding small sections. It is obvious that the pressure required when several holes are provided will be greatly reduced over that for one hole of the same size. Actually, the pressure when using several holes is reduced almost to that for one hole with a sectional area equal to the sum of the smaller ones. It is not unusual, particularly in regular sections of small area, to extrude from as many as six holes simultaneously.

The rod or section emerging from the die is caught in hand tongs and led along a flat, channel section cooling tray extending from the front of the press. After rough hand-straightening here, and cooling to below the plastic range, the rod is moved to a cooling bench and later cut to rod length by the use of a high speed friction saw.

A number of cold finishing operations are carried out on the rod, which shall be described later.

On sizes below $\frac{1}{2}''$ diameter, the cold finishing operations are generally carried out with the metal in coil form. To obtain these smaller sizes in coils, the extrusions may be allowed to cool and coiled cold.

A recent development, however, is the hot coiling machine mounted just in front of the press.

Hot Coiling

Fig. 18 shows one stand of an American three-stand hot coiling machine. For many years, the idea of hot coiling smaller sizes direct from the press was thwarted by the difficulties in closely synchronising the coiling rate and extrusion rate. From a multi-hole die such as is used for the smaller extrusions it is almost impossible, due to thermal gradients in the billet, to have all holes extruding at a similar rate. Therefore, unless each coiling stand can be instantaneously adjusted to the extrusion rate of the rod it is receiving, either stretching of the rod or hopeless tangling will result. In this machine, the speed control problem is overcome by the use of an electronic device which permits instantaneous speed

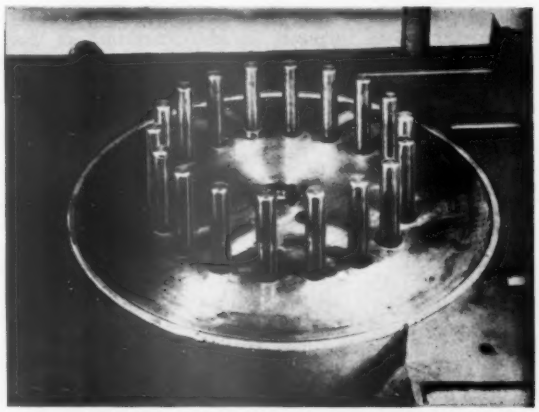


Fig 18

adjustment over a wide range. Extrusions emerging from the die are again led by hand tongs to the coiling table situated some feet in front of the press. The end of the rod is anchored in the hole shown in the coiling plate and coiling around the retractable bars ensues. At the conclusion of extrusion, the bars are withdrawn flush with the coiling stand surface and the hole coil is removed to the cooling stand.

The complete three-stand installation is shown in Fig. 19.

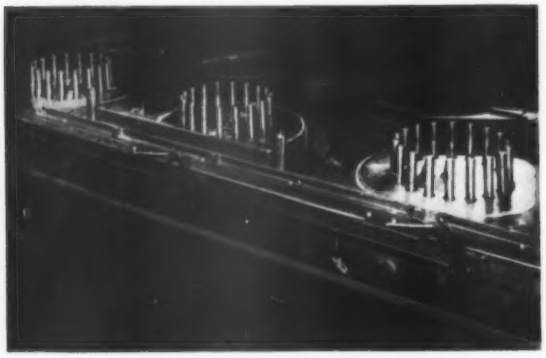


Fig. 19

Finishing Operations

The finishing operations performed on the cooled metal fall into three classes:

1. Pickling, pointing, drawing and straightening larger rod.
2. Straightening sections.
3. Pickling, pointing, drawing and straightening the smaller coiled sizes.

As the material comes from the press, it is liable to show some deviation from the nominal dimensions to which it is being made. The die suffers gradual alterations during use and, depending on such factors as the total weight of the billet, the speed of extrusion, and gradual alteration in the temperature at which the metal passes through the die, variation in diameter between the leading and back end of an extruded length is apt to occur. The variation can be from .010″/.015″.

In many instances, this variation can be tolerated. More often, however, exacting specifications have to be met, and the bars are reduced to within specified tolerances by cold drawing.

The bars are cleaned by pickling in dilute acid solution, a point is turned on one end in point turning machines to permit entry through the die, and drawing is carried out through hardened steel dies or tungsten carbide inserts in draw benches.

The necessary and almost final operation of bar straightening is carried out in the case of round sections in reeling machines.

Concentrations of stress, either mechanically imparted from cold drawing, or present as a result of contraction on cooling, tend to impart a bend to the rod.

The principle behind the various forms of continuous mechanical straightening is to impart to all similar elements throughout the cross-section of the rod, a similar deformation, so neutralising the residual stresses.

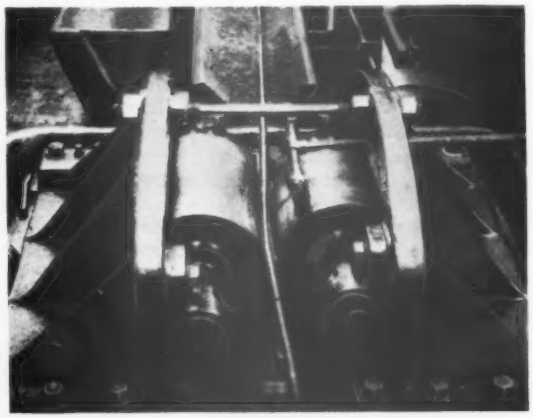


Fig. 20

The bar is reeled between mating concave and convex rolls and, as is well illustrated in Fig. 20, is bent rather severely, while rotating between the rolls. The opposing inclination of the axis of the rolls causes the stock to advance through the machine.

The principle of straightening by similar deformation to similar elements of the cross-section is applied to other symmetrical shapes, squares, hexagons, etc., in multi-roll machines. Here, of course, rotation is impossible; instead, the length of rod progressively suffers slight uniform deformation imposed by the pressure exerted by each successive top roll in a bank of at least six rolls, as the bar passes through the straightening machine.

A pair of pinch rolls feed the stock to a series of staggered rolls. Each top roll is mounted midway

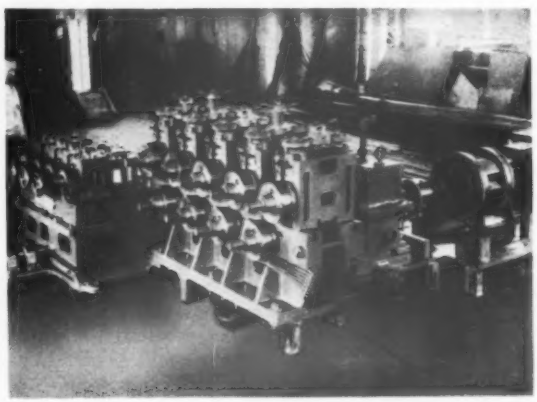


Fig. 21

between the centres of the pair of rolls beneath, and may be adjusted individually to impose sufficient deformation to effect straightening. The formation in a straightening machine of this type is in the vertical plane only.

The machine shown in Fig. 21 embodies a similar principle, but the combination permits deformation in both vertical and horizontal planes, hence complete straightening should be possible in one pass.

Special shapes and sections are less frequently subjected to cold drawing. Dimensional tolerances are generally more generous. However, straightening, particularly of complex shapes, is a definite problem. Some shapes of fairly regular section can be straightened on machines of the type just described. When this is not possible, hydraulic stretching is employed, but there are also limitations here as more intricate sections may be stretched out of shape.

When mechanical means are not suitable, hand straightening must be employed. This is a costly, tedious and time-consuming operation.

The finishing operations for the smaller sizes which are coiled after extrusion are carried out, usually, in a separate section of the plant. The coils are first pickled for cleaning again in dilute acid solution, and one end is pointed. A most convenient method is by stretching the metal while in the plastic state, after heating an end by employing the output of a butt welding machine. Drawing to size, through tungsten carbide dies, is then carried out on bull blocks, where the stock is drawn through the die on to a rotating drum.

The rod in the drawn coil is then straightened in a wire straightening machine.

Adjustable friction rolls in the wire straightening machine draw the stock through a rapidly rotating spinner (Fig. 22). The spinner contains hardened

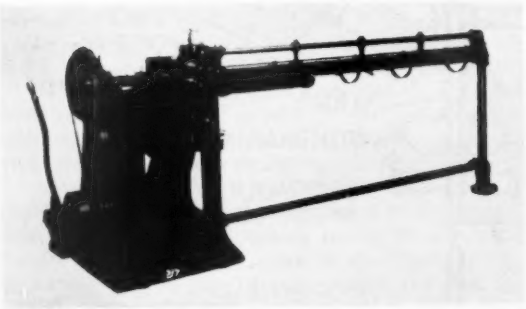


Fig. 22

guides which force the metal to take a rapidly rotating curved path. It is this rapidly rotating curved path which causes the uniform deformation in the metal in this instance and effects straightening. The friction rolls deliver the straightened rod to a shear, which may be arranged for automatic or manual operation, and cuts the stock to rod length.

Combined Finishing Machines

The operations of drawing, cutting and straightening have been successfully combined in a machine by Schumag, which will successively draw, straighten, polish and cut to length, stock from coils up to $\frac{5}{8}$" diameter, and up to $\frac{1}{2}$" A/F for hexagons and similar shapes.

More recently, the Loma Engineering Company has introduced a machine which will perform the combined operations of drawing, straightening, cutting to length, and final straightening and polishing from coiled stock, within the size ranges of $\frac{3}{8}$" - 1" diameter for round and $\frac{3}{8}$" — $\frac{3}{4}$" for square ends. This machine operates at rates of up to 150 feet per minute. The rod on a coil stand is fed into a pre-straightener and out on to a draw bench where motor-driven pinch rollers feed the point through the die. One of two hydraulically-operated carriages on the draw bench first draws the rod through the die. These carriages operate alternately by a reciprocating motion. With one carriage drawing, the other returns to position at a faster rate. Overlapping on the return stroke permits the advancement of the stock in a continuous motion. Wedge-shaped jaws on the carriages respectively grip and release the stock when the forward movement starts, and when the carriage movement is reversed. The hardened jaws have polished surfaces and are of great length, so that the specific pressure is low and no marks are left on the surface of the bar.

The straightener for hexagon and square stock is similar to the type already illustrated. Flying shears cut the stock to length. The length is controlled by a light beam and photo-electric cell located beyond the shears. When the moving stock interrupts the light beam, the cell acts on a solenoid-operated valve, mounted in the shear frame. The shear carriage moves in the frame at a speed synchronised with the advance of the stock and the rod is sheared.

Since a rotary motion is involved, round stock is straightened after cutting to length. The advance of the stock through the round straightener is effected by four motor-driven discs arranged in two sets, each set having two discs opposite each other. The two opposite discs are mounted on different centre lines, so that the rod passing between under high pressure makes a combined rotating and advancing movement. The hardened surfaces of the discs produce a highly polished surface on the rod. The straightening effect is obtained by passing the rod through straightening bushes located between two sets of discs, which are adjustable out of centre and cause the stock to bend in all directions.

Replaceable guide tubes for different lengths are used for passing the rods between the hexagon and square straightener, the shear, the round straightener and a piling-rack at the end of the machine.

Production of Brass Billets for Extrusion

Brass rods and sections are, unless especially ordered, manufactured from an alloy based on the original Muntz metal composition. Muntz metal is the 3 : 2 or 60% copper-zinc alloy. This alloy com-

bines excellent hot working properties with a degree of malleability permitting all but the most severe upsetting operations.

Various alloying additions and the adjustment of copper content within the fairly narrow limits of 60% ± 3% provides the variety of rod and section alloys commonly available.

The production of extrusion billets in these alloys demands fairly close attention to chemical composition for both the major elements and impurities. While impurity limits are not as confined as for the production of 70/30 brass sheet and strip, excessive contamination or the presence of major elements outside the desired limits may render extrusion of the alloy impossible or failure in service probable. Composition control is exercised by the analysis of all raw materials and analysis of every heat of billets cast.

Low frequency induction furnaces have almost universally replaced oil-fired furnaces in the production of brass billets and conferred distinct improvement on the quality of the rod.

The furnace shown in Fig. 23 is operated on a transformer principle. A 'V' shaped channel, extending from the bottom of the furnace pool, always contains molten metal. It surrounds a heavily-wound

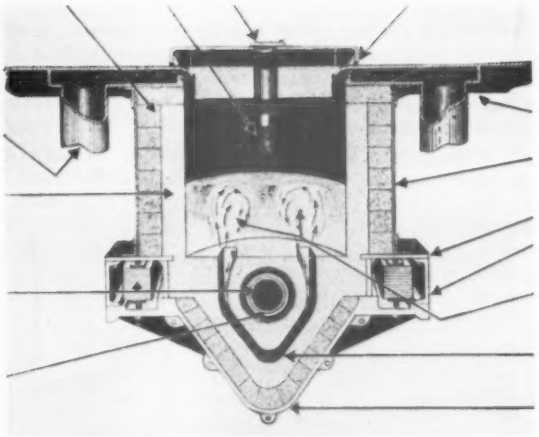


Fig. 23

copper coil, interlinked with an iron core, which functions as the primary of a transformer. Induction in the secondary, from the current fed to the primary, results in a low voltage high amperage current short-circuited around the molten metal channel. The

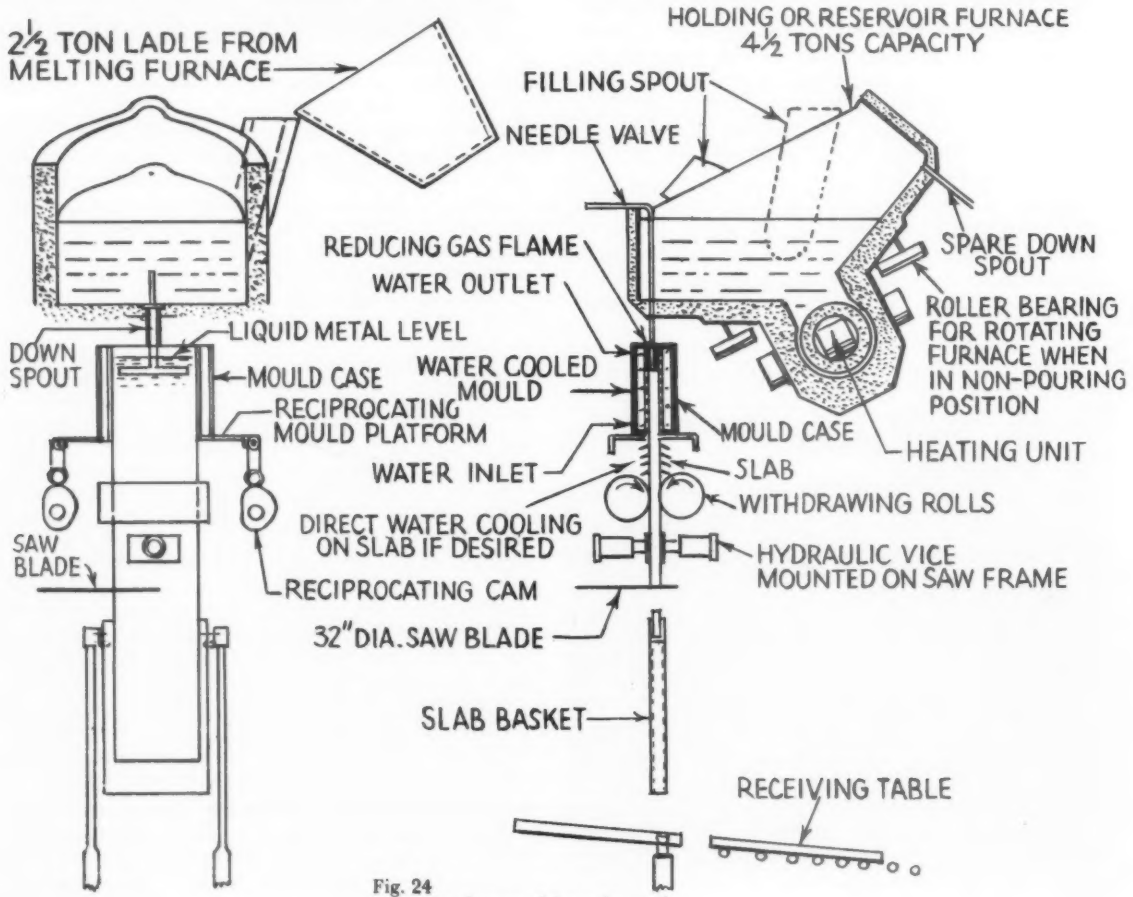


Fig. 24
Continuous slab-casting unit.

operation of such a remotely heated unit is in distinct contrast to the discomfort felt by the furnacemen in the operation of oil-fired furnaces of similar capacity.

In addition, the repulsion of like charges extending vertically into the pool from the channel, provides agitation in the molten pool ensuring complete mixing and hence uniformity of composition in the product is assured.

The molten charge is chill-cast in cannon type cast-iron moulds. After solidification, a hinged plate enclosing the bottom of the mould is swung aside and the billet slides down a chute to be delivered to a cooling floor.

Continuous Casting

Overseas, where the demand for rod and section is much greater, massive installations for continuous casting are justified.

In a continuous slab-casting unit (Fig. 24), molten metal is transferred to a 4½-ton holding or reservoir furnace from a separate melting unit. The reservoir furnace contains a low frequency unit to maintain the metal at the casting temperature.

A bottom pouring method is employed from the reservoir, which has two diametrically-opposed down spouts. The reservoir can be rotated, permitting pouring from either down spout and maintenance to the other as casting is in progress. The pouring rate is controlled by a needle valve operating in the seat of the down spout. Metal from the down spout is received slightly below the liquid metal level in the billet or slab-mould, avoiding any open jet of metal, so eliminating splashing and reducing oxidation of the metal to a minimum. The mould is of a water-cooled copper-faced type. To commence casting, the bottom of the mould is closed by a retractable plate. As solidification above this proceeds, the plate is withdrawn, the solidifying billet then closes the base of the mould, and is itself withdrawn as solidification proceeds.

Hence molten metal received at constant level in the mould solidifies within the length of the mould, under what are ideal cooling conditions for the production of extrusion billets.

A feature of the Junghans-Rossi design of casting machine is that the mould is given a vertical reciprocating motion by cams which act on the mould platform. This motion produces heat-flow conditions in the thin wall of the water-cooled mould, which enable a higher rate of heat extraction to be obtained than is possible in a stationary mould, in which the hottest point, the liquid surface, is always at one level in the mould. A pair of rolls, mounted below the mould, control the rate of billet withdrawal, and a water spray between the mould and rolls may be used further to cool the billet.

A carriage capable of vertical movement carries a metal saw and hydraulic vice.. The vice grips the billet and the desired length is cut as the downward movement of billet and carriage continues. The carriage returns to position and the cut length of billet is transferred mechanically to a receiving table in front of the machine.

A view of a continuous casting machine in the course of construction by the Loma Machine Manufacturing Company of New York is given in Fig. 25.

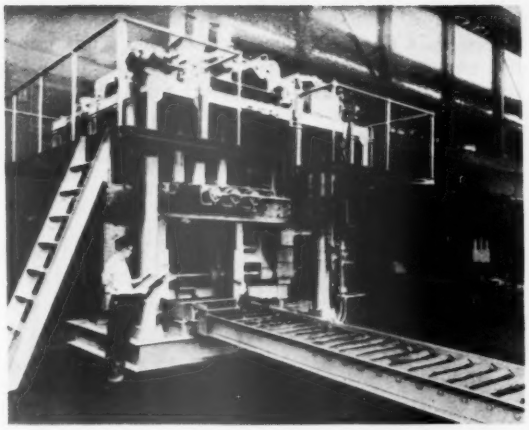


Fig. 25

Alloying Additions to Brass

Various alloying additions are made to 60/40 Muntz metal composition, to provide the range of rod alloys and section metal. Lead up to 3½% is added to enhance machinability. The presence of tin up to 1.5% improves the corrosion resistance of the alloy and is used in this respect as Admiralty or Naval brass. Tin, iron, manganese and aluminium are added, producing manganese bronzes, better named high tensile brass, from which a tensile strength of up to 45 tons per square inch, with good elongation and proof stress values is obtained. The corrosion resistance of this alloy is superior to most other brasses.

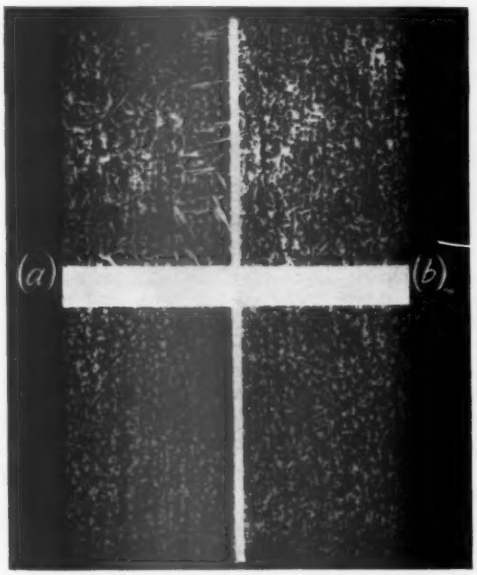


Fig. 26

The rod and section alloys shown in Fig. 26 consist of a duplex structure containing a mixture of the alpha and beta copper zinc constituents. The structure is influenced by the position in the rod.

Fig. 27

A distinct directional effect inherent from the flow during extrusion is obtained and, for this reason, longitudinal mechanical properties are superior to transverse properties in extruded products.

The function of lead in improving machinabilty is of interest. The lead is almost completely insoluble in the brass and exists as scattered small particles, which, as machining is being carried out, offer numerous planes of weakness, facilitating the formation of a short chip. (Fig. 27).

Applications

The uses of extruded brass products are manifold. The fact that, in machinability testing, the normal free machining brass rod composition is assigned the value of one hundred per cent, and used as a standard for comparison, establishes the alloy without doubt as first choice for high speed automatic machining operations. Some thousands of tons of rod in this form are used in Australia each year.

A similar alloy is used in quantity and is preferred by virtue of its excellent hot-working properties, in the production of hot brass pressings. Pressings from blanks and slugs cut from extruded rod continue to replace sand castings, ensuring complete freedom from the inclusions and defects occurring in castings, and greater strength from the dense wrought structure is obtained. Forgings in lesser quantities are readily produced for special applications in the Naval and high tensile brasses.

Fig. 28

Complex shapes unsuitable for forging from round stock may be forged from blanks cut from bars extruded to a suitably shaped section (Fig. 28).

The cold working properties of the rivet metal alloy permit the cold heading in this metal of a wide variety of screws and other shapes. High speed machining operations on the alloy are difficult, but can be carried out under special conditions.

Architectural extruded sections used in a multitude of applications may rely for finish on a brightening effect obtained by alloying, with which only a clear protective lacquer coat is necessary. Alternatively, special colours and finishes are obtained by chemical means.

Finally, extensive use is made of extruded sections providing production short cuts in the manufacture of electrical equipment, in the hardware trade, the automotive industry, for communications in the telephone and telegraph installations, and in various defence projects.

Acknowledgments

In conclusion, the author would like to acknowledge the facilities made available in the preparation of this Paper by my Company, and the assistance given and interest shown by members of the management of the Company.

BRITISH STANDARDS

The following British Standards have recently been issued and may be obtained, post free, from the British Standards Institution, 24-28, Victoria Street, Westminster, London, S.W.1., at the prices stated :—

B.S. 46 Part 1 :1953 Keys and Keyways. (5/-)

B.S. 1133 Section 6 :1953 Temporary Prevention of Corrosion. (10/6)

Section 10 :1953 Metal Containers(10/-)

Section 16 :1953 Adhesives for Packaging. (5/-)

NYLON AS AN ENGINEERING MATERIAL

by E. M. ELLIOTT, A.M.I.Prod.E.

Technical Officer (Engineer), Technical Service and Development Department, I.C.I. Plastics Division.

Presented to the Luton Section of the Institution on 25th November, 1952.

NYLON is now an accepted household word, mainly through the popularity of women's hosiery manufactured in the material, and also because of the increasing use of nylon fabrics for many articles of clothing. It was first synthesised about 20 years ago in America and, after many experiments, it was introduced to the public as tooth-brush fillings. Early development work was mainly directed towards the textile applications and also as filaments for industrial and domestic brush filling. Its use as a moulding material followed and industry has been fairly quick to recognise its toughness, abrasion resistance, strength in thin sections and lightness in weight. These properties, among others, make nylon a very suitable material for many light engineering and domestic applications.

Nylon is a generic name covering a large group of chemical compounds. Variations in chemical constitution provide an almost unlimited range of materials having different properties suited to a wide variety of uses. For the purposes of this Paper, however, the discussion will be limited to the properties, moulding technique and applications of one grade only, that is, the grade now used for injection moulding in this country. No doubt, in due time, other grades of nylon will be available for injection moulding, and it is possible that these grades will increase the range of engineering applications. But, for the present, the discussion will be limited to the grade known in this country as " AF " and in America as " 10,001 ".

Properties of Moulded Nylon (Grade " AF ")

Nylon is reasonably easy to mould and parts having very thin sections may be produced. Such mouldings have great strength when compared with similar pieces made in other plastic materials. In addition to those properties already mentioned, nylon has good resistance to attack by chemicals.

The mechanical properties of moulded nylon are shown in Table 1. The values given are average properties measured on injection moulded test specimens.

Properties of Nylon " AF " — Mechanical

From the figures quoted, it is seen that nylon is one of the lightest plastic moulding materials, compared with 0.92 for polythene, 1.12 for polystyrene, 1.27 - 1.63 for cellulose acetate and 1.30 - 2.10 for phenolics.

The average tensile strength of over 10,000 lbs per sq. in. is one of the highest among plastic materials and enables equal strengths to be obtained in many instances, with reductions in cross section and weight compared with other materials. Impact

TABLE I

Properties of Nylon " AF "—Mechanical

Property	*Unit*	*Value*	*Test Method*
Tensile strength	lbs./sq. in.	10,000—11,500	ASTM-D638
Elongation	%	80—85	" "
Young's Modulus in bend	lbs./sq. in.	$3.0—4.0 \times 10^5$	" "
Cross breaking strength	lbs./sq. in.	$12—15 \times 10^3$	BSS 771
Impact strength	ft. lbs./$\frac{1}{2}$" notch	1—1.5	BSS 771
Hardness	—	12	Vickers Diamond
Specific gravity	—	1.14	—

strength is similar to that of high impact phenolic materials, and is maintained at low temperatures to a greater degree than in many other moulding materials.

Nylon tends to be hygroscopic, the moisture content being in equilibrium with the ambient humidity. Figure 1 shows the equilibrium moisture content at various relative humidities.

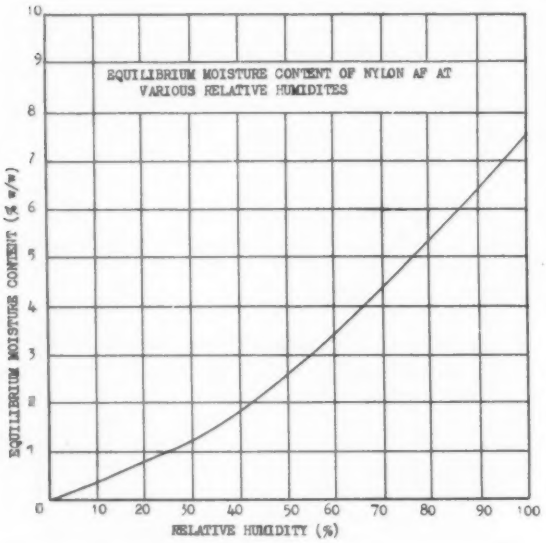


Fig. 1

Dimensional stability of mouldings in the presence of moisture is superior to that obtained with cellulose materials, which are also slightly hygroscopic. The extent of dimensional change varies with the shape of mouldings but, as an example, a test piece 5″ x ½″ x ⅛″ increased in length by 0.008″/in. between zero moisture content and saturation, saturation being achieved only after very lengthy immersion in water. Increases in moisture content have the effect of increasing impact strength, but decreasing stiffness. The variation of impact strength with moisture content is shown in Fig. 2, whilst Fig. 3 shows the effect of moisture content on bend strength.

Nylon "AF" has a high, sharp melting point at 263°C and, when molten, has a low viscosity. It has no plastic range, that is, it does not pass through a "rubbery" stage like other thermoplastics, and increases in temperature above the melting point produce relatively small changes in viscosity. This difference between nylon and another typical thermoplastic material is shown in Fig. 4.

The high melting point and low viscosity give a free flowing material which enables mouldings, even of thin sections, to be produced relatively free from residual strains. It follows that the effects of temperature on mechanical strengths are less pronounced than for the more common thermoplastics. Demoulding does not occur in unstressed mouldings until temperatures in the region of 230°C are

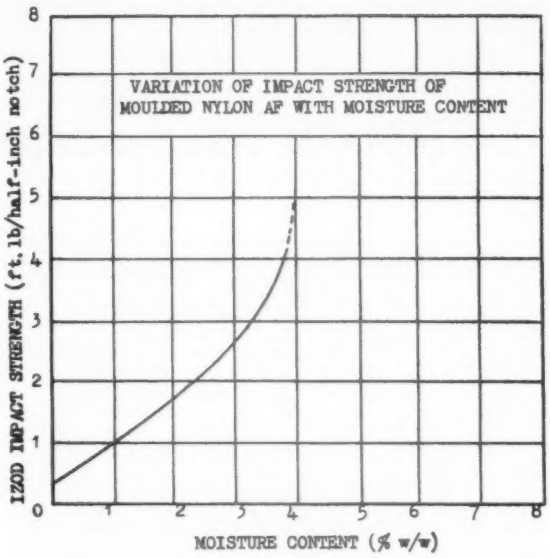


Fig. 2

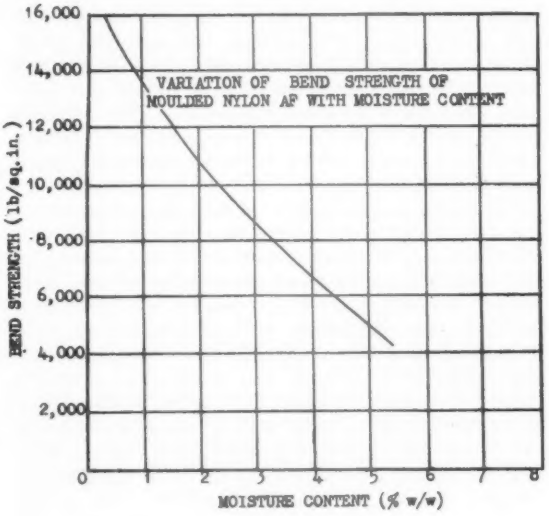


Fig. 3

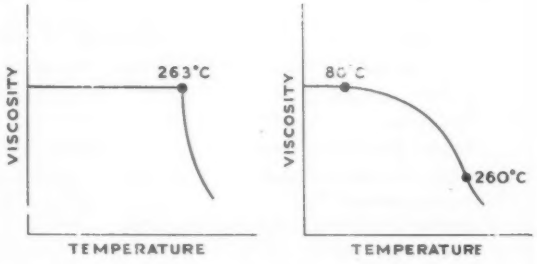


Fig. 4

TABLE II

Properties of Nylon " AF "—Thermal

Property	*Unit*	*Value*	*Test Method*
Heat distortion temperature	—	—	—
264 lb./sq. in.	°F	167	ASTM-D648
66 lb./sq. in.	°F	392	" "
Specific heat	—	0.4	—
Coefficient of linear expansion	in/in/°F	5.5×10^{-5}	—

reached. It is not recommended, however, that nylon mouldings should be subjected to prolonged exposure in air at temperatures above 150°C., since such treatment will cause discolouration and some loss in mechanical properties.

Increases in temperature have the effect of increasing impact strength, but decreasing tensile strength. This is shown in Figs. 5 and 6.

The thermal properties of moulded nylon " AF " are given in Table II.

The electrical properties of nylon are not outstanding, especially when compared with polystyrene and polythene. It is, however, used where toughness, low weight and high temperature resistance are required with reasonable electrical properties. Table III gives details of the electrical properties.

Nylon is resistant to attack by common organic solvents, alkalis, dilute mineral acids, lubricating oils, petrols and paraffins. It is soluble in formic acid and phenols and is attacked by strong mineral acids.

Prolonged service under cover causes no appreciable change in the properties of nylon, but outdoor exposure to strong sunlight and weathering places limitations on its applications.

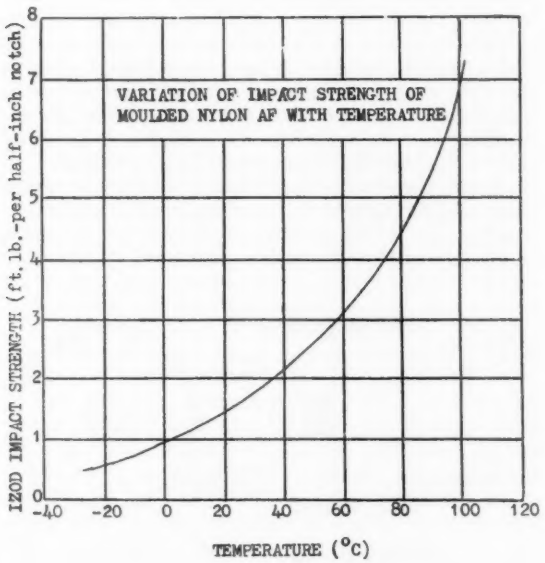


Fig. 5

Injection Moulding

Reference has already been made to the sharp melting point at 263°C and to the low viscosity at melt. The tendency of nylon to absorb moisture has also been mentioned. These characteristics make necessary the use of a special technique for injection moulding. Compression moulding of this grade is not recommended, owing to the high fluidity at melt and therefore a serious danger of splashing; further, the absence of any plastic range, and the tendency to discolour when heated in air, exclude the use of this method of production to make mouldings in nylon.

The moulding powder is dried to a specified moisture content under controlled humidity conditions, and is packed in hermetically-sealed containers for delivery to moulders. It must be kept in these sealed containers until it is actually required for immediate use, as exposure to normal room conditions for two hours will allow the material to absorb sufficient moisture to cause serious difficulties when moulding, and any mouldings which may be produced will have poor surface finish and inferior properties. For example, tensile strength and impact strength do not appear to be affected by slight moisture content in the powder within the

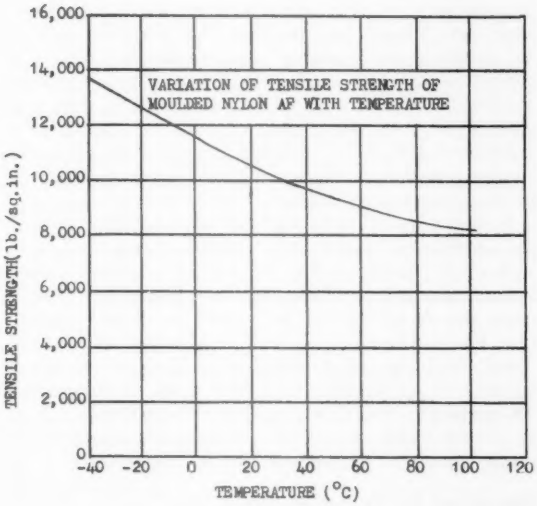


Fig. 6

TABLE III

Properties of Nylon "AF"—Electrical

Property	*Value*
Dielectric strength 25°C 50% R.H.	350-400 V/mil.
Volume resistivity 25°C 50% R.H.	5 - 10 x 10^{16} meg. ohm. cms.
Dielectric constant at 10^2 cycles	4.0
25°C 50% R.H. 10^6 cycles	3.4
Power factor at 10^2 cycles	0.02
25°C 50% R.H. 10^6 cycles	0.04

mouldable range, but there is an appreciable falling-off in elongation to break as moisture content rises.

In order to obtain the best conditions, it is usually recommended that only sufficient powder for 30 to 40 minutes working should be placed in the material feed hopper at any one time. This may mean that the contents of the container will not be used within the specified time; in this case, it is necessary to provide containers into which the balance of the material may be tipped, so that it can again be immediately sealed. Attempts have been made to store powder in ovens heated to about 75°C., but this has not always been successful, as the relative humidity at this temperature can be sufficiently high to allow the nylon to absorb moisture. If dry air only can be circulated in the oven, this method is generally satisfactory.

Scrap material, that is, sprues and runners, may be re-ground, dried and re-used, but the proportion of re-ground material to virgin powder should not exceed 50%. Where 100% reclaimed material has been used, it has been found there is a falling off in the mechanical properties, especially in elongation. The most convenient method of reclaiming scrap is to install a small disintegrating machine adjacent to the injection machine, to re-grind the sprues and runners and to return the re-ground material immediately to the injection machine. This saves time and labour and prevents the material picking up moisture and surface contamination.. It is, of course, necessary to check the weight of the re-ground material used, in order to ensure that it does not exceed 50% of the charge to the cylinder of the machine. Ideally, a modified hopper should be used so that virgin and re-ground material can be metered in the correct proportions.

It may not always be convenient to use this method, as sometimes sprues and runners may be of a sufficiently heavy section to require crushing before passing through the distintegrating machine. In this case, the scrap has to be stored in clean, covered bins for re-processing. After re-grinding, it must be dried, and the most efficient method is to use a vacuum dryer working at 100°C under a vacuum of 29" mercury; the time required is from 3 to 4 hours. It is preferable to blend re-ground material with virgin material before the drying operation.

Machines for Injection Moulding

Normal injection moulding machines with slight modifications may be used for the production of nylon mouldings. It is desirable to use a multiplicity of independently-controlled heater bands along the plasticising chamber, and to use a spreader giving the maximum heating area. Special alloys or protective finishes are not necessary as nylon does not attack, nor is it attacked by, clean steel surfaces.

The clearance between cylinder and plunger should be 0.002 - 0.003"/inch of diameter and the plunger should preferably be arranged for water cooling. When moulding thick section articles, the plunger is held forward in the hot zone for a major part of the time cycle and it is possible, under these conditions, for molten nylon to seep back along the plunger unless adequate cooling facilities of the plunger are available. If the clearance between plunger and cylinder is excessive, the seepage fault is accentuated.

The low viscosity of nylon at melt calls for the use of a specially designed nozzle, which will restrict free flow and so prevent drooling from the nozzle between moulding cycles. A large number of designs have been tried; in general, fittings relying on moving parts or springs have been found to be unsatisfactory when the moving parts have been in contact with molten nylon, due to loss of temper and lack of streamlined flow, so that pockets of "dead" material form which quickly become overheated. Some machine tool manufacturers can now supply nozzles which give a positive cut-off by means of a plunger working in a lapped bore; the operation being automatically controlled by the machine operation.

A comparatively simple nozzle, which is widely used and has proved to be effective in use, is shown in Fig. 7. This consists of a number of plates, preferably made in stainless steel, each drilled with

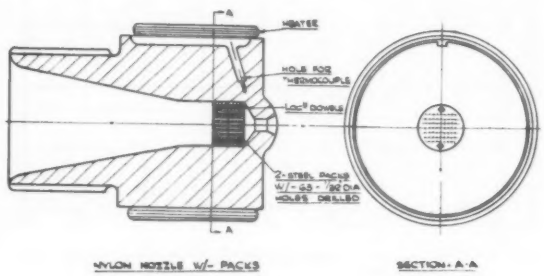


Fig. 7

a series of 1/32" dia. holes. The plates are dowelled together to keep the 1/32" dia. holes in line. In a nozzle used on a 4 oz. machine, the number of 1/32" dia. holes recommended is 62. This number of holes is varied in direct proportion to the capacity of the machine, a nozzle for an 8 oz. machine having 124 holes. The finish on the 1/32" dia. holes should be reasonably good.

The function of such a pack of plates is firstly to prevent the passage of any particles of nylon which have not melted; the second function is to prevent drooling from the nozzle. This is accomplished by the frictional resistance to flow in the small diameter holes, and a careful temperature control on the nozzle which is equipped with a heater band and independent temperature control. The pack should be placed as close to the tip of the nozzle as is practicable with strength, and a reverse taper should be machined in the front of the nozzle. The object of this is to enable that portion of the material in the end of the nozzle which "freezes" when the nozzle is in contact with the comparatively cold mould, to be easily pulled from the nozzle on the end of the sprue, so leaving the nozzle clear for the next shot.

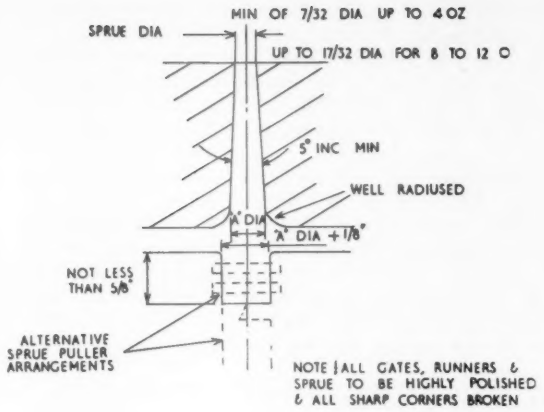
Heating cylinders, with their temperature control equipment, should be designed to work up to 300°C. Injection pressures of 16,000 lbs/sq. in. on the material are usually satisfactory, but it is desirable to have pressures up to 20,000 lbs/sq. in. available.

Mould Design

The general principles underlying injection mould design apply to moulds made for use with nylon. It is, however, necessary to give more attention to certain details than when designing and making moulds for other thermoplastic materials.

A good, well-proportioned, cold slug well is considered necessary to receive the first material from the nozzle, which may be rather low in temperature, thus allowing a stream of properly heated nylon to flow along runners and into mould cavities without obstruction. Runners and gates should be of adequate proportions to permit easy flow and the application of follow-up pressure, as the material "freezes". This follow-up pressure is made necessary due to the high volumetric contraction of 16% when nylon changes from the molten to the solid state. If the pressure were not maintained to feed fresh melt as solidification takes place, the mouldings would suffer from the inclusion of voids and would show bad sink marks; this applies particularly to sections of $\frac{1}{8}$" and over. Fig. 8 shows recommended proportions for sprue and cold slug well.

The average mould shrinkage allowance is in the order of 0.015"/in., but a full investigation into allowances for shrinkage is not yet complete. It has been found, however, that they are dependent on length and cross-section of runners, position and size of gate and mould temperature in addition to moulding conditions. High mould temperatures increase shrinkage, the rate of increase being approximately 0.001"/in. for each 10°C rise. Injection temperature,


MIN OF 7/32 DIA UP TO 4 OZ
SPRUE DIA
UP TO 17/32 DIA FOR 8 TO 12 O
5° INC MIN
WELL RADIUSED
'A' DIA
'A' DIA + 1/8"
NOT LESS THAN 5/8"
ALTERNATIVE SPRUE PULLER ARRANGEMENTS
NOTE ALL GATES, RUNNERS & SPRUE TO BE HIGHLY POLISHED & ALL SHARP CORNERS BROKEN

SKETCH OF SPRUE & COLD SLUG WELL

Fig. 8

pressure and speed at which pressure is applied, as well as time cycle, are all relatively important and influence the shrinkage which takes place. It therefore follows that in order to obtain consistent results, a very close control on all the factors in the injection moulding cycle must be maintained. Further, it is recommended that before finishing moulds, they should be tried out in the injection machine under carefully controlled conditions and a check made on the actual shrinkage which has taken place. The mould can then be corrected, tried out and checked again, and finally finished. It is important to use the same moulding conditions at any trials subsequent to the first, and also when the work goes into production, as any deviation from the original moulding conditions may affect the contraction ratio.

Arrangements must be included in the mould design for heating and controlling the temperature of the mould and must be capable of working up to 135°C. The actual temperature used varies with the thickness of the article being moulded; the figures given in Table IV are indicative of mould temperatures used for different sections.

Accurate control of mould temperature is essential if shrinkage is to remain constant.

The free-flowing properties of nylon make necessary rather more care in the manufacture of moulds than is usually the case. It is essential to ensure that any moving parts, such as ejector pins,

TABLE IV

Mould Temperature v.s. Section

Section	*Mould Temperature*
3– 5 m/m	20 - 40°C
5–10 m/m	60– 80°C
10–15 m/m	90–100°C
> 15 m/m	100–135°C

are fitted with the minimum clearance in order to prevent molten nylon seeping between the pin and its housing. If seepage occurs around ejector pins, or in any other part of the mould, extraction from the mould is made very difficult. Mould mating faces must be carefully finished in order to prevent any leakage across these faces. It is advisable to provide guards over the mating faces, to stop any molten nylon which might fly from between them in the unlikely event of mould locking pressure failing. A burn from molten nylon can be quite serious.

Attention must be given to proper venting of mould cavities in order to allow air to escape. This is very important when moulding nylon, as it flows very easily and rapidly fills the mould.

Moulding Procedure

Cylinder and nozzle temperatures vary with machine and mould and can only be established by trial. Generally, the cylinder temperature should be such that the temperature of the melt is between 265°C and 280°C. It is desirable to arrange a temperature gradient so that the maximum temperature is at the front end of the cylinder, with a slight drop at the nozzle. This drop assists in the control of drooling.

When charging an empty cylinder, the injection pressure should be dropped to about one-third of the working pressure and with the feed device set to give the correct amount of material to make one shot, the injection plunger should be operated at the estimated overall time cycle, so that as fresh material is passed to and along the cylinder, it becomes properly heated. When the cylinder is full, molten material will issue from the nozzle. In appearance this should be a clear, light honey-coloured stream of light oil. If it is in this condition, it is ideal for making mouldings. Should it expand and have a "frothy" appearance, the material has either become wet or it has been overheated in the cylinder. Having obtained the correct conditions at the nozzle, the mould is brought into contact with it, and with the fixed platen secured, the moulding operation is carried on in a normal manner, care being taken to ensure constancy of time cycle.

Machining Nylon Mouldings

In some cases, the number of pieces required may not warrant the manufacture of an expensive mould. In these instances, the production of a simple nylon moulded blank may be arranged from which the finished articles can be machined.

Like other thermoplastics, nylon is a bad conductor of heat. It is, therefore, necessary to ensure rapid dissipation of heat by using correct tools, speeds and feeds and a flow of coolant. In general, methods for machining free turning brass are satisfactory. For sawing, band saws are preferred to circular saws as, with the former, there is better opportunity to dissipate heat through the length of the band saw. Nylon may be drilled, threaded and tapped using standard equipment, but coolants are recommended. It is somewhat difficult to file, but grinds readily, using a soft wheel and water as coolant. Wet sanding is recommended, as dry sanding causes overheating and "gumming". Final polishing may be obtained with fine sandpaper and a buffing wheel lightly dressed with tallow.

When components have to be machined from thick blanks, it is often beneficial to carry out the work in two stages, interposing a strain-release operation. This is recommended because machining may develop an unbalanced strain which did not exist in the original moulding, or alternatively, it may release strain from the moulding, and so lead to a reduction in dimensional stability. It is suggested the article be machined to within, say, 1/32" of finished size and then be placed in water at room temperature for 24 hours for each $\frac{1}{8}$" of section. It should then be dried in an air oven at 70°C for the same length of time that it was in the water, after which final machining may be carried out.

Applications

The major use for nylon mouldings is in the light engineering industry and a considerable number of gears, cams, bearings and similar parts have already proved to be economical in production and use. Manufacturers of office equipment including typewriters, tabulating machines and duplicating machines are using nylon mouldings to an increasing extent in the place of parts previously made in metal. Food preparation machines and textile plant also use nylon parts and make use of their ability to run without lubrication, thus reducing the risk of contamination in the product prepared.

The use of nylon in bearings is still comparatively new, but experience has established certain general principles. Dissipation of frictional heat by coolants or by design of bearing is of major importance. Thin sections are recommended, as they show less tendency to overheating and are generally more stable dimensionally.

There are three orders of lubrication—none, water and oil—related respectively to low, medium and heavy loadings. An examination of performance reports indicates that the maximum loadings for these conditions are, approximately, 500, 1,000 and 1,500 lbs/sq. in. Surface speeds must also be taken into account.

The question of clearances in nylon bearings is still under investigation, as 0.005"/in. diameter has proved satisfactory in certain instances, whereas 0.006"/in. has been insufficient in others. There is, little doubt that the optimum clearance is decided by such factors as surface finish, speed, loading, lubrication and temperature and each application should be examined independently.

Information on gears is somewhat limited, although very successful results have been obtained in many cases, and there is justification for the development of nylon in this field. Nylon gears provide quiet running with fairly high shock resistance. Generally, little or no lubrication is required, and they can withstand abrasive atmospheres which will break

down other materials such as brass or phosphor bronze.

In the electrical industry, its major use is for coil forms where, moulded in thin tough sections, it enables overall dimensions to be reduced or more windings to be put in a limited space. Further, the risk of damage through flange breakages is very much reduced when compared with other plastic materials.

Nylon is used for a number of medical and surgical applications. The best known of these is probably the mounts for hypodermic needles. Nylon brush backs filled with nylon monofilaments are used in hospitals, as they can be sterilised by boiling or steam autoclave.

The applications mentioned are only indicative of the uses to which nylon mouldings are being put and the list is not by any means complete. As more information is obtained on the behaviour of nylon mouldings under different conditions, so, no doubt, the range of work to which it is adapted will be increased.

It is hoped that this Paper will have given some idea of the properties and uses of the material and methods used in the production of nylon mouldings, for there is little doubt that it is now well established in the moulding industry as a material to be used for light engineering applications. As a recent development it has already made quite rapid progress.

COMMUNICATIONS

Comment is invited on Papers published in the Journal.
Communications should be addressed to the Editor,
36, Portman Square, London, W.1.

"THE TECHNIQUE OF CARBIDE TOOLING"

From: Mr. Geo. V. Stabler, B.Sc.(Hons.), M.I.Mech.E., M.I.Prod.E., Senior Lecturer in Production Engineering, Royal Technical College, Glasgow.

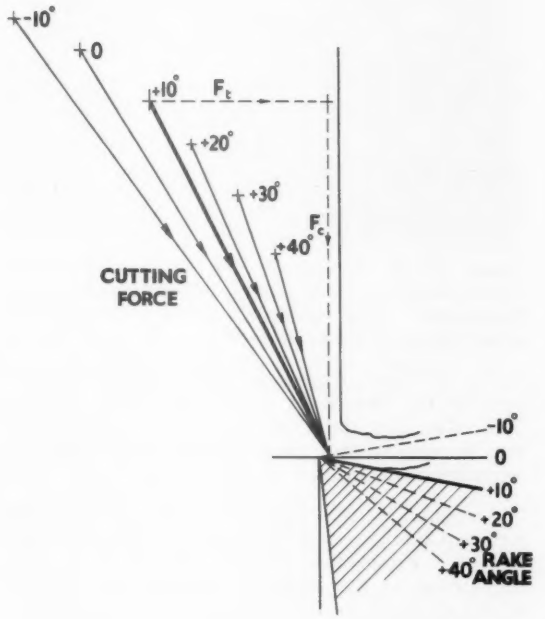
The value of Mr. Lord's Paper* is marred by a number of assumptions regarding metal cutting which are not in accordance with provable facts.

An instance is Fig. 11, which has had a good deal of publicity elsewhere. It, and the associated text, clearly give the impression that the force of work on a positive rake tool has a component towards the work, and even claims that positive rake causes additional rubbing on the front clearance face. The opposite effect is claimed for negative rake. This is quite inaccurate, and the error is repeated in connection with Figures 9 and 10.

A tool force dynamometer was used to find the effect of rake when cutting steel, by measuring two components of the cutting force, F_c in the direction of cutting and F_t normal to F_c. The results are shown in the accompanying diagram, in which the resultant cutting force, R, is shown in direction and magnitude for ten degree steps from—10° to +40°. An attempt to find the force for a +50° tool resulted in immediate digging in and in fracture of the tool. It is quite evident that the moment F_t becomes negative, as in Fig. 11, the tool becomes impractical. All practical tools are pushed away from the work by the cutting force. The continuous reduction in F_t with increase in rake has the effect of REDUCING any possible effect of the force on clearance face wear.

The above experiment was carried out by the writer about twenty years ago, and by others long before that. It is almost routine in Higher National Certificate Course work in Production Engineering.

Mr. Lord appears to be unaware of the published research on tool geometry and chip flow. In commenting on Fig. 4, he claims that negative 'front



* March, 1953, Journal.

to back angle', more properly called 'angle of obliquity', has the effect of making the chip flow away from the work. This is incorrect; such negative conditions cause the chip to flow TOWARDS the work by an angle equal to the obliquity (the writer's $\beta = \delta$ law). The chip could flow away from the work only if the plan approach angle was greater than the negative obliquity, a condition which is met by most tools.

Mr. Lord replies:

I am very grateful to Mr. Stabler for providing me with the opportunity of explaining what I had hoped would be apparent to those concerned with the explanation of the mechanics of metal cutting.

It should be clear, from the general content of the Paper as a whole, that its purpose was to introduce to prospective tungsten-carbide users, or those users of limited experience, information which would enable them to apply carbide tools with less risk than would be the case were the user to adopt indiscriminate modification of HSS techniques. It was, therefore, decided at the outset that, in order better to meet the needs of those to whom the Paper was presented (it will be recalled that this was delivered in India), a practical approach would be more effective than a theoretical treatment.

To this end, use was made of some schematic diagrams of which Figure 11 is, without doubt, an over-simplification amounting to inaccuracy. As Mr. Stabler has pointed out, this particular diagram enjoys widespread use in various carbide tool manufacturers' literature, to attempt to explain in a readily understandable fashion, the condition referred to, namely, the generally observable greater incidence of flank wear on positive rake tools, than on negative rake tools as commonly employed.

The writer suggests that the manufacturers' use of such a diagram is in many cases more effective in promoting acceptance of the fact of flank wear, than would be the alternative of what would have to be a somewhat superficial treatment of the as yet incompletely explored theories underlying metal cutting. It can be supposed that the manufacturers concerned have in mind the ability of advanced workers, on the one hand, to recognise the divergence between what may be called training methods and established theory, and the infinitely greater danger of the confusion which may easily arise in the minds of those, on the other hand, to whom their recommendations are especially directed, by the present incompleteness of the understanding of some aspects of tool wear and the machining process.

In connection with Mr. Stabler's last comment, the tendency referred to in the Paper of chips to flow away from the work when employing tools having a negative front to back angle, was observed using standard No. 130 series tools as illustrated in Figure 4; these have an approach angle of 10° and a negative front to back angle which depends on the cutting rake, but is in no case more than 3°. This is, I think, clear from the diagram in the Paper and the tools do, of course, conform to the limitation referred to by Mr. Stabler.

I.C.W.A. CONFERENCE, 1953

The 24th National Cost Conference of the Institute of Cost and Works Accountants will be held in London on the 28th to 30th May and will open with the President's Reception at Londonderry House.

The Conference Sessions will be held at the Royal Festival Hall, South Bank and will be opened on Friday morning with the Presidential Address by Mr. S. C. Tyrrell, F.C.W.A., F.I.I.A. This will be followed by a technical session with discussion on the report of the Institute's Research and Technical Committee on "Employee Remuneration and Incentives". The Friday afternoon session will consider "Business Forecasting".

The Institute's Annual Banquet and Dance will be held at the Dorchester Hotel, on Friday evening, 29th May, and the Conference will terminate with the Annual General Meeting of the Institute on Saturday morning.

Accountants from overseas who may be in London for the Coronation are cordially invited to the Conference. Prospective visitors are asked to make application to the Director, Institute of Cost and Works Accountants, 63 Portland Place, London, W.1.

RESIDENTIAL TRAINING FOR FOREMEN

The Institute of Industrial Supervisors reports on further developments in the provision of residential training facilities for foremen and supervisors. Four residential course programmes have now been developed, as follows:

Course I:	"The Practice of Supervisory Management".
Course II:	"Human Relations, Communication and Discipline for Supervisory Management".
Course III:	"Work Study for Supervisory Management".
Course IV:	"Industrial Relations and Industrial Law–What the Supervisor Should Know".

The subjects included in these Courses are designed to be of direct help to foremen, and the courses are planned to promote the exchange of experience by discussion and case studies, and by practical exercises and demonstrations in addition to the direct presentation of information.

Further information may be obtained on application to the Institute's General Secretary, Mr. A. J. Mansell, at Bank Chambers, 47, Temple Row, Birmingham, 2.

INSTITUTION NOTES

RESIGNATION OF THE EDUCATION OFFICER

Council have, with great regret, accepted the resignation of the Education Officer, Mr. T. B. Worth, M.I.Mech.E., A.M.I.E.E., M.I.Prod.E., F.R.S.A., who is returning to teaching. Mr. Worth will be relinquishing his appointment at the end of June, 1953, to return to the Birmingham College of Technology, where he will again be responsible for the Production Engineering work of the College.

The five-year period of Mr. Worth's appointment with the Institution has seen a substantial growth in the expansion of facilities for studies in Production Engineering. Largely as a result of his efforts, the number of colleges offering courses for the Higher National Certificate in Production Engineering has been almost doubled, whilst for the first time, production subjects have been included in a variety of other courses.

In addition to this work in the field of formal educational activities, in which such splendid progress has been made, many members will recall the invaluable advice and guidance which they have received from Mr. Worth on matters connected with the education and training of the young Production Engineer. He has visited all parts of the United Kingdom in the course of his duties and has been tireless in his endeavours to further the Institution's educational policy.

Mr. Worth was educated at the Wyggeston Grammar School and subsequently at the Leicester College of Technology and Commerce, where he obtained Higher National Certificates in both Electrical and Mechanical Engineering. After an indentured apprenticeship, he became Assistant Electrical and Development Engineer with Wadkin, Limited, before taking up an appointment in 1937 as Lecturer in Engineering at the Leicester College of Technology.

In 1944 he moved to Birmingham to take over the Production Engineering Section at the then Central Technical College. In 1948, he joined the staff of the Institution as Education Officer.

He will take with him to his new appointment the Institution's best wishes for his future success and happiness.

GRADUATE REPRESENTATIVES' CONFERENCE, 1953

The Third Annual Graduate Representatives' Conference, which took place at Halifax on the 28th and 29th March, 1953, can be described as an outstanding success.

The quality of the contributions by the various speakers was of a high standard, and led to combined positive action being taken in a number of matters of common interest to all Graduate Sections.

The Conference was presided over by Mr. R. S. Cracknell. Conference guests were: Mr. Harold Burke, Chairman of Council; Mr. J. Blakiston, President of the Halifax Section; and Mr. H. Peter Jost, Member of the Editorial and Papers Committees.

The Conference was opened by Mr. Burke, who drew a comparison of the work of the Institution of Production Engineers in this country with that of its President, Sir Cecil Weir, on an international basis.

The first major question to be discussed was the "Status and Importance of Graduates and the Activities within the Institution." This theme was discussed in great detail, with special reference to the Report of the Special Committee on Organisation, and Graduate activities on a regional and national basis. Mr. Burke was subjected to a barrage of questions dealing with the anticipated working of various parts of his Organisation Report as affecting Graduates.

This photograph taken during the Graduate Representatives' Conference shows (left to right) Mr. Harold Burke (Chairman of Council); Mr. J. Taylor (Conference Secretary); Mr. R. S. Cracknell (Chairman, Halifax Graduate Section); Mr. A. G. Bradbury; and Mr. H. P. Jost (Member of the Editorial and Papers Committees).

In summing up, Mr. Burke stated that it was hoped that Graduates would extend their activities on a regional and national basis over a period of time. He felt that a Graduate had a great and important part to play in the future of the Institution.

During the discussion of the second main point, "The Duties and Standing of a Section Registrar,"

it soon became evident that quite a number of Sections had run, some of them for quite a considerable number of years, schemes to record attendances, producing statistics therefrom, and analysing the results in order to attract greater audiences to the Institution activities. It soon became obvious that in this work there had been no co-ordination between the Graduate Sections, and the Conference felt that such co-ordination was essential to prevent a great deal of unnecessary effort being expended by many individual Sections, due to such lack of co-ordination. It was, therefore, agreed that the best way to avoid this state of affairs was to have somebody in the nature of a National Registrar, whose task would be to collate and disseminate the findings of the Section and Regional Registrars.

A meeting of the three Midland Graduate Sections for further discussions on this point was arranged.

Conference Dinner

On Saturday night a Conference Dinner was held. A speech of welcome to the guests was made by the Conference Secretary, Mr. J. Taylor, and responded to on behalf of the guests, by Mr. H. Peter Jost.

The Sunday Session was opened by Mr. J. Blakiston, the Halifax Senior Section President, and the discussion was on the methods of inducing high attendances at Graduate meetings and the selection of Papers. The discussion revealed an apparent divergence in the experience of individual Sections, but it was generally felt that a high standard of Papers was of great importance and that the occasional introduction of a Production Panel or Brains Trust was desirable.

Amongst the activities of the Graduate Section Committees, it was interesting to hear that in an unofficial way, one Papers Committee of a Graduate Section had made contact with the local office of the B.B.C. and that another Section had been instrumental in introducing a Course at the local Technical College.

There was a great deal of controversy on the question of broadening the base of the Institution, raised by the Manchester Graduate Section. Whilst the desirability of such policy was generally acknowledged, it was felt that there were a great number of implications in the practical execution of such policy. This was brought out with considerable force on the discussion of the necessity of basic technical training.

It was felt by some delegates that whilst the training of a Production Engineer in the metal working industries might enable him to fulfil a Production Engineering function in the non-metal working industries, the reverse might not be the case, and arising therefrom the necessity for basic technical training in the metal working industries would appear an important part of the general training of Production Engineers.

It was decided that the election of the Graduate Section which is to convene next year's Conference should be held by postal ballot, so that all Graduate Sections could express their opinion. The choice will be between Wolverhampton and Coventry.

Graduates attending the Conference wish to express their gratitude to members of the Halifax Senior Section Committee, who made a substantial financial contribution towards the cost of the Conference, thus considerably easing the burden of costs to be borne by the Graduates themselves.

A vote of thanks was passed to the Halifax Graduates who had extended hospitality to visiting delegates, and the Conference ended with the speech of the Conference President, and delegates who had come from as far away as Glasgow and Bristol left, well satisfied with the outcome of the week-end's work.

THE SIR ALFRED HERBERT LECTURE, 1953

Members are reminded that the Sir Alfred Herbert Lecture, 1953, will be presented on the 24th July, 1953, at the Sheldonian Theatre, Oxford, at 5.30 p.m. The speaker will be Sir John Cockcroft, C.B.E., F.R.S., who has chosen as his subject "Industrial Applications of Atomic Energy."

Members who wish to attend this lecture are requested to make early application to the Secretary of the Institution for tickets of admission, using the form included in the Supplement to this month's Journal.

NORWICH SUB-SECTION MEETING

Mr. E. C. Gordon England, M.I.Prod.E., recently addressed the Norwich Sub-Section on "Further Thoughts." This photograph, taken during the evening, includes (left to right) Mr. V. Crowther (Section Committee Member); Mr. K. S. Jewson (Section Chairman); Mr. K. R. Addison (Section Hon. Secretary); Mr. Gordon England; Mr. L. D. R. Dunsford (Asst. Hon. Secretary); and Mr. C. H. Frewer (Past Section Chairman)

JOURNAL BINDERS

Members are advised that binding cases for the new size Journal are now available, and may be ordered from Head Office. The cases, which are strongly made and covered in dark red leather cloth, with "The Institution of Production Engineers Journal" in gilt on the spine, will each hold 12 copies of the Journal. The price per case is 10/-, post free.

A limited number of binding cases for the old size Journal are also available, at the reduced price of 2/6d. per case, post free.

This group, photographed at the Birmingham Section Dinner Dance, includes, left to right: Mr. E. Percy Edwards, a Member of Council and Past-President of the Birmingham Section; Mr. J. France; the Lady Mayoress of Birmingham; Lord Sempill, A.F.C.; Mrs. J. France; Mr. H. Burke; Mrs. H. Burke; the Lord Mayor of Birmingham; Major General K. C. Appleyard, C.B.E.; Mr. T. Fraser, C.B.E.; and the President of the Institution, Sir Cecil Weir, K.C.M.G., K.B.E.

BIRMINGHAM SECTION DINNER DANCE

The Annual Dinner Dance held by the Birmingham Section on Saturday, 21st March, 1953, was, as usual, an extremely successful and enjoyable function. The occasion was distinguished by the presence not only of the Lord Mayor and Lady Mayoress of Birmingham, but also by the President of the Institution, Sir Cecil Weir, K.C.M.G., K.B.E., two Past-Presidents, Lord Sempill, A.F.C., and Major General K. C. Appleyard, C.B.E., a Vice-President of the Institution, Mr. T. Fraser, C.B.E., and the Chairman of Council, Mr. H. Burke.

During the course of the evening Lord Sempill, on behalf of the Birmingham Section, presented, as an expression of appreciation, a crystal table lamp to the retiring Section President, Mr. J. France, and Mrs. France.

Lord Sempill making the presentation to Mr. and Mrs. J. France.

TEXTILE INSTITUTE CONFERENCE, 1953

The 38th Annual Conference of the Textile Institute will this year take place in Llandudno, from 25th/29th May.

Visitors will discuss some 14 papers given by prominent British and American scientists and technologists on "Structure and Purpose — Structural Design and Testing of Textile Materials for Specific Purposes". These will cover a wide range of subjects, such as man-made fibres, felt for paper-making, jute, furnishing and other fabrics used for industrial purposes; functional properties, design, serviceability and tensile strength testing will be discussed, with emphasis on fitness for purpose, from raw material to finished product.

Full particulars and copies of the programme may be obtained from the Development Officer, The Textile Institute, 10, Blackfriars Street, Manchester.3.

Important

In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

Research Publications

A number of copies of the following Research publications are still available to members, at the prices stated:

Report on Surface Finish, by Dr. G. Schlesinger	15/6
Machine Tool Research and Development	10/6
Practical Drilling Tests	21/–

These publications may be obtained from the Production Engineering Research Association, "Staveley Lodge," Melton Mowbray, Leics.

NEWS OF MEMBERS

MR. L. E. BUNNETT

Mr. Leonard E. Bunnett, A.F.R.Ae.S., M.I.Prod.E., has relinquished his post as Assistant Director in the Technical Costs Branch of the Ministry of Supply, to establish himself as a Management Consultant, with offices in Guildford, Surrey.

(Courtesy of "The Aeroplane")

Mr. L. E. Bunnett

After serving his apprenticeship at a textile machine factory in Nottingham, Mr. Bunnett had experience of automobile, electrical and steam turbine works before joining the Air Ministry in 1929. During the expansion period of 1938, he was Technical Adviser to the Directorate of Sub-contracting, set up to widen the field of aircraft manufacture, and throughout the greater part of World War II, he headed a team of production efficiency experts who advised firms on methods of increasing their production.

Mr. Bunnett was a member of the Management Accountancy Team which visited America in 1950.

MR. R. BROADBENT

A prominent member of the London Section of the Institution, Mr. R. Broadbent, Member, Director and General Manager of the Sperry Gyroscope Company, has been appointed Chairman of the Brentford and Chiswick Employment Committee.

Before joining Sperry's in 1943, Mr. Broadbent was Assistant Director of Instrument Production at the Ministry of Supply.

MR. S. R. CAUTHERY, O.B.E.

Mr. S. R. Cauthery, O.B.E., Member, has been appointed Assistant Engineer-in-Chief (PR), Admiralty, Foxhill, Bath. Prior to this appointment, Mr. Cauthery was Chief Engineer in charge of Production, Inspection and Test with the British Electricity Authority, London.

MR. FREDK. H. HARRIS

Mr. F. H. Harris, Member, has been appointed Production Adviser to the Associated British Engineering Group. Mr. Harris was formerly Works Manager for B.S.A. Tools, Birmingham. He served his apprenticeship with the British Thomson-Houston Company, and is a first-class Honours Graduate of London University.

After completing his apprenticeship, he became Industrial Engineer with B.T.H. and later joined Alfred Herbert Ltd., as Production Controller.

Mr. Harris visited the U.S.A. in 1951 as Secretary of the A.A.C.P. Productivity Team on Machine Tools.

MR. WILLIAM SCOTT

Mr. William Scott, Member, has been elected to the Council of the British Steel Castings Research Association, a new research body formed by the British Steel Founders Association. The main policy of this new body will be to put into industrial practice as quickly as possible the best production techniques.

Mr. Scott, who is Managing Director of Jarrow Metal Industries Ltd., and of Sir W. G. Armstrong Whitworth & Co. (Ironfounders) Ltd., is a Past President of the North-Eastern Section of the Institution and has been associated with the industry on Tyneside for more than 30 years.

MR. JOHN W. DAVIES

The Institution sends warm wishes for speedy recovery from a serious illness to Mr. John W. Davies, a Founder Member.

Mr. Davies, who was elected to the Board of Ferranti, Ltd. in 1942, has been with the firm since its earliest days, being appointed General Works Manager in 1924.

MR. D. H. MASON

Mr. D. H. Mason, Member, has resigned his position as Technical Costs Engineer with The de Havilland Engine Co. Ltd., and has accepted an appointment as Production Project Officer in the Directorate of Engine Production, Ministry of Supply. Mr. Mason, who joined the Institution in 1939, renders valuable service as a member of the London Section Committee and of the Hazleton Memorial Library Committee.

Mr. D. H. Mason

MR. F. V. WALLER

Mr. F. V. Waller, Member, Managing Director of Western Manufacturing (Reading) Ltd., left the United Kingdom last month to make a business tour of Canada and America.

Mr. Waller is well-known to members as President of the Reading Section of the Institution.

NEW APPOINTMENTS

Mr. John N. Colledge, Associate Member, has recently commenced business on his own account in London, as Industrial Consultant, specialising in matters of Production, Design and Development.

Mr. H. Ellis, Member, has been elected a Director of Woodhead Components Ltd., Sheffield, a leading Subsidiary of Jonas Woodhead & Sons Ltd.

Mr. A. Jacobs, Associate Member, has taken up an appointment as Chief Planning Engineer with Armstrong Siddeley Motors Ltd., Coventry.

Mr. J. E. Lissaman, Associate Member, has sailed for New Zealand to take up an appointment with the New Zealand Government, Wellington, as Inspector of Machinery.

Mr. G. F. N. Martin, Associate Member, has resigned his position as Managing Director of Wm. C. Gray & Sons Ltd., Ayr, and has taken up an appointment as Deputy Chairman to Henry Widnell & Stewart Ltd., Bonnrigg, Midlothian.

Mr. A. Nicholls, Associate Member, has taken an appointment as Design Engineer, Special Weapons, Department, Canadair Ltd., Montreal.

Mr. D. Rigg, Associate Member, has taken up duties with Vickers Armstrongs Ltd., in charge of their Chilbolton Aerodrome.

Mr. G. Stowe, Associate Member, is now employed by J. Mercer & Sons Ltd., Christchurch, New Zealand, as Production Engineer.

Mr. R. Telford, Associate Member, has been appointed General Works Manager of Marconi's Wireless Telegraph Co. Ltd.

Mr. P. J. Thyer, Associate Member, has been transferred to the Glasgow Branch of Remington Rand Ltd., and has taken up the position of Quality Co-ordinator at their typewriter factory.

Mr. C. M. P. Willcox, Associate Member, is now in sole charge of technical sales of pneumatic equipment with Benton & Stone Ltd., Birmingham.

Mr. V. Yarwood, Associate Member, has taken up an appointment as Assistant Planning Officer with the Ministry of Supply, Division of Atomic Energy.

Mr. C. Chamberlain, Graduate, has joined the staff of Airmec Ltd., High Wycombe, as Senior Tool Designer.

Mr. J. S. Langford, Graduate, has been appointed Works Manager of Fordham Pressings Ltd., Wolverhampton.

Mr. W. G. Peters, Graduate, has taken an appointment as Production Engineer with The Wilkinson Sword Co., Colnbrook, Bucks.

Mr. M. C. Ray, Graduate, is now a Technical Engineer with the Standard Vacuum Oil Co. Ltd., Calcutta.

Mr. J. Taylor, Graduate, is now employed as a Production Engineer with The Holset Engineering Co. Ltd., Huddersfield.

HAZLETON MEMORIAL LIBRARY

Members are asked to note that the Library will be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week. Due to Meetings, the full facilities will not be available at the following times during this month :—

Tuesday, 12th May from 2 p.m.
Wednesday, 20th May from 2 p.m.
Thursday, 14th May all day.
Tuesday, 26th May from 2 p.m.

It would be helpful if, in addition to the title, the author's name and the classification number could be quoted when ordering books.

REVIEWS

331.225 INCENTIVE SCHEMES

" Incentive Management . . . A New Approach to Human Relationships in Industry and Business ", by James F. Lincoln. *Cleveland Lincoln Electric Co.*, 1951. 280 *pages.* $1.50.

Mr. Lincoln is an individualist in his approach to management problems, and in this book expresses points of view on the true incentive and the responsibilities of the employer to the actual controller of any industry —the customer. He states . . . " The worker, (which includes management), the customer, the owner and all those involved, must be satisfied that they are properly recognised or they will not co-operate, and co-operation is essential to any and all successful applications of incentives ".

He stresses the need for the development of method and that " Industry must eliminate jobs " in order to produce continually more at lower prices as the only means to increase the standard of living. Many comparisons are drawn between his own philosophy of individual enterprise and other types of control, particularly cartels, control of profit and governmental control in the U.S.A. and Western Europe.

Considerable emphasis is laid on the development of the individual; he states . . . " Development is latent in every person, but few recognise the fact and fewer still will put themselves under the pressure or by chance are put under pressure that will develop them greatly ".

In addition to dealing very fully with all aspects of incentives that can operate in a society or company, he deals with the effective size of an organisation and the place of the union. Finally, as an appendix, there are numerous statistics relative to the progress of manufacturing costs of the Lincoln Electric Company's products compared with those of other organisations and the general trend of wages, prices and costs. G.R.B.

621.9 MACHINE TOOLS : MACHINING

" New Processes for Machining and Grinding ". *U.S.A.—National Research Council—Minerals and Metals Advisory Board. Washington, National Research Council,* 1952. 86 *pages. Diags.* $2.25. (*Report No. MAB-18-M.*)

In the United States there is a shortage of diamond bort; consequently, an investigation has been made to determine where the best economies can be made to conserve supplies. It has been established that the

grinding of single point tungsten carbide cutting tools accounts for a consumption of 50% of the diamond bort supply.

Because of this condition, the possibility of using other methods of machining and grinding tools and other hard material is receiving consideration.

This Report really consists of a series of papers describing in detail the following processes for grinding and machining: (1) Electrolytic; (2) Electro-sparking; (3) Electro-arcing or electro-errosive; (4) Ultra-sonics.

In the first part of the Report, a short description is given of each process, followed by a discussion of the potential value as compared with the diamond methods.

Following this introduction, there are nine appendices which enlarge in considerable detail what has already been said. The concluding papers describe again the new machining processes—but this time the description is such that a working knowledge can be obtained.

This document must not be considered as a text book. To Production Engineers in this country, the domestic problems of the United States as regards diamond bort supplies has a different aspect and cannot therefore be the incentive that would lead us to investigate new machining technique. Nevertheless, a careful perusal of the descriptions would be sufficient for anyone to start experimenting with these methods of stock removal. The Report indicates that there are many applications of the processes other than carbide tool grinding. The writer is of the opinion that here much worthwhile work can be done.

Although the Report appears to be rather disconnected, each article is complete in itself and is presented in a clear manner. References are given in sufficient detail to enable them to be followed up where necessary. R.E.M.

002 DOCUMENTATION

"Punched Cards, Their Application to Science and Industry," edited by Robert S. Casey and James W. Perry. *New York, Reinhold Pub. Corp.,* 1951. 506 *pages, illus., diags.* £4 0s. 0d.

The Editors of this symposium, involving some thirty authors, with biographical details, have taken as their main theme the application of punched cards to statistical analysis and evaluation of research and scientific data, with a definite bias towards chemical applications.

The book in its entirety substantiates the fact that the all-important virtue of punched cards in any form is the ability to sort.

Part One comprises an excellent introduction to the basic principles of numerous systems employing in some form, holes punched in cards, but is restricted to equipment manufactured in the United States of America. British manufactured machines are referred to in Parts Two and Three where specific applications are dealt with. Coding is synonymous with the application of punched cards and this aspect of the subject is also dealt with.

Finally, the book contains a good bibliography, but still mainly within the more narrow confines of the application of punched cards to science and research, and there are also indices of subjects and authors. F.G.S.E.

ABSTRACTS

621.56 REFRIGERATION

"Commercial and Industrial Refrigeration" by C. Wesley Nelson. *London, McGraw-Hill,* 1953. 467 *pages, illus., diags.* £2 10s. 0d.

The title of this work suggests a wider field than is actually covered by the author. The book deals with the vapour compression system and associated evaporators, automatic controls, etc. In the preface, the author explains that the term "commercial" is applied to the preservation and processing of food and the term "industrial" is used in the text with emphasis on sizes up to about 20 h.p.

The book is written in simple language and illustrated with diagrams and photographs of American-built components, condensing units, evaporators, refrigerant and electrical controls. The first three chapters are devoted to Basic Principles and Refrigerants and subsequent chapters deal with major components used in the vapour compression system, Installation, Service Operations and Air Conditioning.

A chapter entitled Load Calculations and Equipment Selection includes tables listing capacities of one manufacturer's finned and forced-air evaporators and another manufacturer's air and water-cooled condensing units up to 5 h.p.

The American Standard Safety Code for Mechanical Refrigeration, B9.1-1950 is reproduced in the Appendix.

621.2 HYDRAULIC SYSTEMS AND MACHINES

"Operation and Care of Hydraulic Machinery." *Texas Company. London, Regent Oil Co.,* 1949. 85 *pages, illus., diags.*

The engineering student will find this booklet useful as an introduction to hydraulics. The subject matter is presented systematically and a brief introduction is followed by an explanation of the fundamental principles underlying all hydraulic systems. A large number of photographs and coloured diagrams are included to illustrate each stage of the text quite adequately for a newcomer to the subject.

The various types of pumps, valves, cylinders, fluid motors, reservoirs and accumulators are dealt with in detail, as also are the alternative methods of tubing hydraulic systems. The section on hydraulic oils indicates the various tests which can be made and explains the use of additives.

389.6 STANDARDISATION

"Recent Developments and Techniques in the Maintenance of Standards". *National Physical Laboratory, Teddington, Middx. London, H.M.S.O.,* 1952. 100 *pages, illus. diags.* 4/6d.

The proceedings of a two-day Symposium held at the N.P.L. in May, 1951, when six standards were discussed, i.e. primary load; length; radioactive isotopes; temperature; light; and frequency.

Two papers were read at each of the six Sessions, and these are published in full, together with summaries of the discussions.

In the Session discussing the standards of length, the first paper by E. Engleherd considers the present state of a light wave standard of length and items of interest included the Kosters double prism, also the P.T.R. interferometer for comparing light waves with the metre. The second paper in the same Session, by H. Barrell, considers the interferometry of length and summarises a great deal of information relevant to absolute measurement by light waves. There are 28 references to this paper.

The book is illustrated with 26 line drawings and 15 half-tone plates.

PAPERS RECEIVED

1941: **"Low Temperatures in Science and Industry"** by Dr. N. Kurti.

1942: **"Simplification for Production"** by A. B. Brown.

1944: **"Measurement in Gear Manufacture"** by R. D. B. Stone.

1946: **"Planing Machines and Practice"** by G. Butler.

1947: **"The Mass Production of Bolts and Nuts"** by P. J. O'Leary.

1949: **"Administrative Problems of Industry"** by Sir Patrick Hannon.

1950: **"Management and Production"** by H. Bainbridge.

The Council of the Institution

1952/53

President
Sir Cecil Weir, K.C.M.G., K.B.E., M.C., D.L.

Chairman of Council
H. Burke

Vice-Chairman of Council
G. R. Pryor

Past Presidents
Major-General K. C. Appleyard, C.B.E. The Rt. Hon. Viscount Nuffield, G.B.E.
Dr. Herbert Schofield, C.B.E. J. D. Scaife

Vice-Presidents
J. E. Blackshaw, M.B.E. T. Fraser, C.B.E. J. E. Hill Walter C. Puckey

Sub-Council Presidents
AUSTRALIAN SUB-COUNCIL—Sir John Storey
SOUTH AFRICAN SUB-COUNCIL—R. H. Arbuckle

Section Presidents

J. H. Law ..... *Adelaide*
J. France ..... *Birmingham*
R. A. P. Misra ..... *Bombay*
J. D. Mookherjee ..... *Calcutta*
C. J. Luby ..... *Canada*
Capt. F. W. Spencer ..... *Cornwall*
E. M. Price ..... *Coventry*
T. Broome ..... *Derby*
J. Butler ..... *Dundee*
A. H. Leggett ..... *Eastern Counties*
E. W. Barrell ..... *Edinburgh*
W. P. Kirkwood ..... *Glasgow*
J. Blakiston ..... *Halifax*
S. Radcliffe ..... *Leicester*
E. Burgess ..... *Lincoln*
J. O. Knowles ..... *Liverpool*
R. Kirchner ..... *London*
N. A. Maskell ..... *Luton*
R. H. S. Turner ..... *Manchester*
B. G. Ross ..... *Melbourne*
J. A. Holmes ..... *New Zealand*
J. S. Elliott ..... *N. Eastern*
S. Annesley ..... *N. Ireland*
E. Barrs ..... *Nottingham*
H. Kirkman ..... *Preston*
F. V. Waller ..... *Reading*
G. E. C. Gilfillan, O.B.E. ... *Sheffield*
H. Bainbridge ..... *Shrewsbury*
R. H. Arbuckle ..... *S. Africa*
F. C. Cooke ..... *Southern*
E. S. Gregory ..... *S. Wales & Mon.*
J. E. Strick ..... *Sydney*
G. W. Wright ..... *Western*
Capt. Leighton Davies, C.B.E. *W. Wales*
R. Beasley ..... *Wolverhampton*
S. G. Haithwaite ..... *Yorkshire*

Additional Section Representatives

E. Percy Edwards ..... *Birmingham*
H. W. Harper, M.B.E. ... *Birmingham*
C. J. Swain ..... *Coventry*
H. Gardner ..... *Glasgow*
W. Core ..... *London*
A. L. Stuchbery ..... *London*
R. K. Allan ..... *Luton*
H. G. Gregory ..... *Manchester*
H. Spencer-Smith ..... *Manchester*
J. Henderson ..... *N. Eastern*
E. G. Eaton ..... *Preston*
J. H. Hartley ..... *Sheffield*
R. S. Brown ..... *Western*
C. L. Old ..... *Wolverhampton*
H. Tomlinson ..... *Wolverhampton*
F. T. Nurrish, M.B.E. ..... *Yorkshire*

Chairmen of Standing Committee
W. J. T. Dimmock J. France C. M. Holloway Sir Lionel Kearns, C.B.E., Lord Sempill, A.F.C. R. L. Paice M. Seaman

Elected Members
A. J. Aiers H. W. Bowen, O.B.E. E. D. Broome R. M. Buckle J. E. Burnett B. H. Dyson R. C. Fenton
P. G. Garside B. G. L. Jackman Prof. T. U. Matthew H. J. Swift, O.B.E. F. Bernard White

Overseas Sub-Councils

AUSTRALIA

President
Sir John Storey

Chairman
J. E. Strick

Vice-Chairman
B. G. Ross

Elected Members
S. Downie J. B. Finlay W. Gwinnett E. Herbert C. E. Jones J. H. Law J. O. Ogden C. Pullen J. M. Steer
L. W. Worthington

SOUTH AFRICA

President
R. H. Arbuckle

Vice-President
W. G. Gillespie

Past Presidents
A. B. Anderson L. H. L. Badham G. Godfrey J. Henry D. Lion-Cachet J. Renwick A. C. Wotherspoon

Elected Members
D. N. S. Clare V. J. S. Donnelly C O. Doehring H. J. G. Goyns A. P. R. Hodge D. A. Petrie G. M. Pratley
L. F. Roberts H. H. Waters

SUB-SECTION CHAIRMEN

L. E. Broome ..... *Gloucester*
K. S. Jewson ..... *Norwich*
L. P. Coombes ..... *Oxford*
A. P. Peat ..... *Peterborough*
J. J. Gleeson ..... *Rochester*
R. R. Kenderdine ..... *South Essex*
H. Porter ..... *Stoke-on-Trent*

Education Officer
T. B. Worth

Secretary of the Institution
W. F. S. Woodford

SECTION HONORARY SECRETARIES

AUSTRALIA

Adelaide (South Australia) ...	W. Hemer, 6, Bedford Street, Brooklyn Park, South Australia.
Melbourne (Victoria, Australia) ...	R. W. Deutscher, W. A. Deutsher (Pty.) Ltd., 374/80, Point Nepean Road, Brighton, S.6, Victoria, Australia.
Sydney (N.S.Wales)	J. B. Finlay, Room 802, 16, Barrack Street, Sydney, Australia.

CANADA

Canada	T. H. Beard, 144, Glendale Avenue, Toronto.

INDIA

Bombay	M. W. Hall (Acting), I.Prod.E., c/o National Machinery Manufacturers Ltd., Kalwe, Thana, Bombay, India.
Calcutta	J. Warren-Boulton, c/o Machine Tools (India) Ltd., Stephen House, Dalhousie Square, Calcutta.

NEW ZEALAND

New Zealand	H. R. Holmes, Pah Road, Papatoetoe, Auckland.

SOUTH AFRICA

South Africa	The Secretaries, Institution of Production Engineers, Barclays Bank Buildings, Corner Commissioner and Harrison Streets, Johannesburg.

UNITED KINGDOM

Birmingham	A. J. Mansell, 204, Alcester Road South, Birmingham, 14.
Cornwall	F. G. Hawke, 17, Church Road, Pool, Redruth, Cornwall.
Coventry	R. F. Eaton, 232, Longfellow Road, Coventry.
Derby	A. Short, 244, Uttoxeter Road, Mickleover, Derby.
Dundee	K. Fairweather, c/o D. Morrison, 13, Kersview Terrace, Dundee, Angus.
Eastern Counties	A. B. Brook, Davey Paxman & Co. Ltd., Britannia Works, Colchester.
Edinburgh	A. Atkinson, Priory House, South Queensferry, West Lothian.
Glasgow	W. H. Marley, Coltness Foundries, Newmains, Lanarks.
Gloucester and District	P. C. Bradshaw, Dunsworth Cottage, Norton, Gloucs.
Halifax	Miss N. E. Bottom (Acting), Hopkinsons Ltd., Huddersfield.
Leicester and District	A. T. Vasey (Acting), c/o Wadkin Ltd., Green Lane, Works, Leicester.
Lincoln	H. Wright, 101, Longdales Road, Lincoln.
Liverpool	L. C. Jarman, 17, Cambridge Road, Prenton, Birkenhead.
London	R. Hutcheson, Machine Shop Magazine, Dorset House, Stamford Street, London, S.E.1.
Luton	J. F. W. Galyer, Engineering Dept., Luton & South Beds., College of Further Education, Park Square, Luton.
Manchester	R. S. Clark, 13, Fownhope Road, Ashton-on-Mersey, Sale, Cheshire.
North Eastern	C. C. Hodson, Alfred Herbert Ltd., Carliol Square, Newcastle-upon-Tyne.
Northern Ireland	W. G. Wyman, "Linden Lea," Cultra, Co. Down.
Norwich Sub-Section	K. R. Addison, c/o Engineering Dept., Norwich City College, Ipswich Road, Norwich.
Nottingham	C. N. T. Manfull, Chellaston House, Thurgarton Street, Nottingham.
Oxford Sub-Section	M. J. Inston, 53, Rymers Lane, Cowley, Oxford.
Peterborough Sub-Section	E. G. Perrett, 61, Bridge Street, Peterborough.
Preston	F. T. Graham, 254, Whalley New Road, Blackburn, Lancs.
Reading	R. W. H. Mark, "The Beeches," 41, Reading Road, Woodley, Berks.
Rochester and District Sub-Section	W. G. Clements, 101, Featherby Road, Gillingham, Kent.
Sheffield	E. Levesley, The English Steel Corporation, Ltd., Sheffield.
Shrewsbury Section	J. A. Francis, "Meole Meads," Bank Drive, Longden Road, Shrewsbury.
Southern	J. W. Taylor, 44, Deacon Road, Bitterne, Southampton.
S. Essex Sub-Section	P. H. W. Everitt, 6, Hillcrest Road, Loughton, Essex.
South Wales and Mon.	W. D. Porter, 49, Kyle Avenue, Rhiwbina, Cardiff.
Stoke-on-Trent Sub-Section ...	R. Rowley, North Staffordshire Technical College, Stoke-on-Trent.
Western	A. Eustace, 19, Ferndale Road, Northville, Bristol, 7.
West Wales Section	H. P. Sanderson, I.C.I. Ltd. (Metals Division), Waunarlwydd, Nr. Swansea.
Wolverhampton	W. J. Marshall, Central View, Norton-in-Hales, Market Drayton, Shropshire.
Yorkshire	J. L. Townend, 26, Moor Allerton Drive, Street Lane, Leeds, 7.

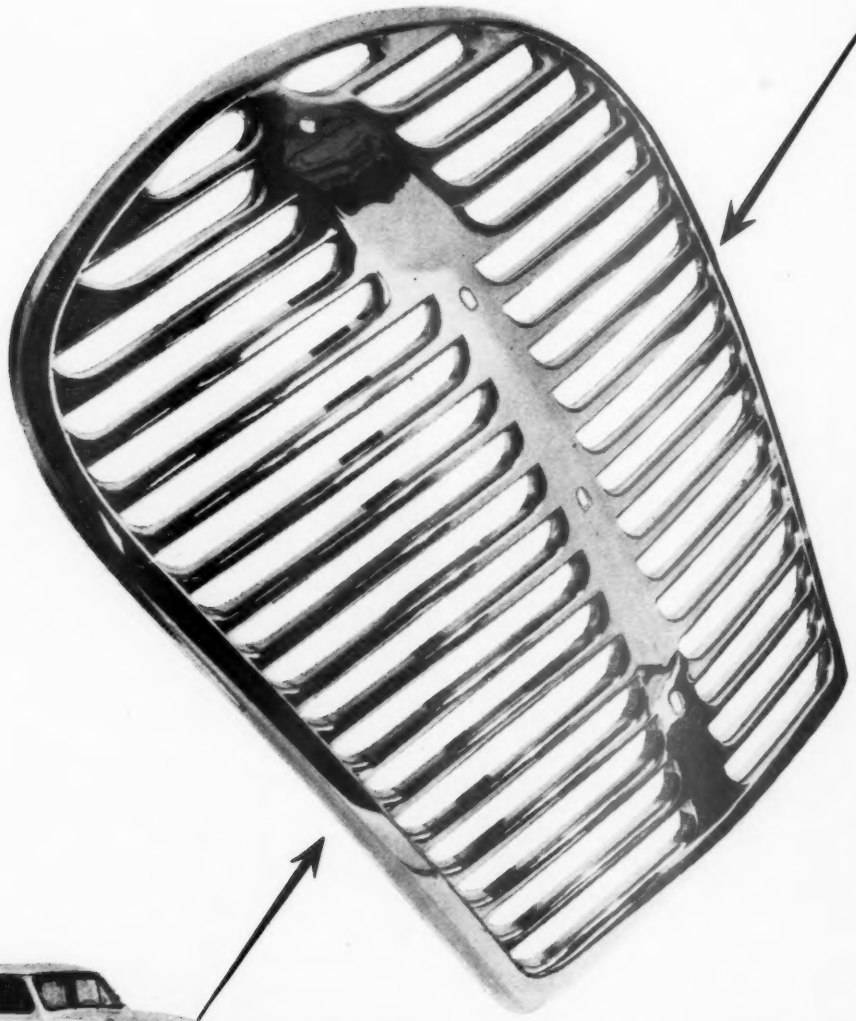
CORRESPONDING MEMBER IN THE MIDDLE EAST

J. Merkine, 45, Arlozoroff Street, Ramat-Gan, Israel

GRADUATE SECTION HONORARY SECRETARIES

Birmingham	W. Silberbach, 44, Linwood Road, Handsworth, Birmingham, 21.
Coventry	L. B. Rutter, 1, The Countess's Croft, Cheylesmore, Coventry.
Halifax	J. Taylor, 32, Hill Top Road, Paddock, Huddersfield.
Liverpool	C. W. Haigh, 2, Richmond Avenue, Haydock, Lancs.
London	F. Rutter, 67, Sefton Avenue, Mill Hill, London, N.W.7.
Luton	C. S. Brewer, 44, Beverley Road, Luton, Beds.
Manchester	J. D. Evans, 85, Windsor Road, Denton, Nr. Manchester.
North Eastern	A. Gilmore, 19, Lynwood Avenue, Blaydon-on-Tyne, Co. Durham.
Sheffield	G. Shaw, C. & J. Hampton, Ltd., Sheffield, 2.
Western	C. H. Spearing, Severn View, Easter Compton, Nr. Bristol.
Wolverhampton	W. L. Pace, "Linden," 10, Ezekiel Lane, Short Heath, Willenhall, Staffs.
Yorkshire	G. Horner, 9, Broughton Street, Skipton.

O N E P I E C E



Hours of production are saved when a component like this can be die cast, as one piece, as no further processing is necessary. MAZAK based on zinc of 99·99+% purity has all the essential qualities that permit die castings to be of exceptional size and complexity.

MAZAK

Now supplied in *1 ton pallets to ensure safety and ease of handling*

IMPERIAL SMELTING

U.K. MEMBER OF THE CONSOLIDATED ZINC CORPORATION LIMITED

IMPERIAL SMELTING CORPORATION (SALES) LIMITED · 37 DOVER STREET · LONDON W1

Higher Output

Our customers tell us:

we have been able to bring out good work while reducing the total time from 5 to 1.	1: 5
from 87.2 minutes to a time of 9 minutes. This constitutes a reduction in cost from 2/9d. to 3d. (=1:9.7).	1: 9,7
Worm Shaft previous turning time 63 minutes now 16 minutes	1: 4
our present results stand at 1:8 in comparison with previous output on a special lathe.	1: 8
Setting-up time reduced approx.1:24	1: 24
Previous tool and fixture costs on multi-tool lathes and automatics have dropped approx. 1:20	1: 20
Setting-up time has been reduced 1:7 and production is equivalent to 2 previous multi- cut lathes.	1: 7

+GF+
COPYING LATHE

Sole U. K. Selling Agents
Sidney G. Jones, Ltd.
8, Balham Hill Phone Battersea 3246 London S.W.12

WZ 66-4

Confidence in Equipment is essential.

FOR OVER SIXTY YEARS

HORDERN, MASON & EDWARDS LTD.

have considered reliability to be of paramount importance in the design and manufacture of

POWER PRESSES

for **BLANKING, PIERCING, FORMING, DRAWING, RAISING, HOT BRASS STAMPING, etc.**

HME

HORDERN, MASON & EDWARDS LTD

PYPE HAYES, BIRMINGHAM, 24, ENGLAND. Telephone: ASHfield 1104 (7 lines) Telegrams: "Aitchemmee" B'ham.

LONDON OFFICE:- 4, VERNON PLACE, SOUTHAMPTON ROW, W.C.1 Telephone:- HOLborn, 1324

MARBAIX

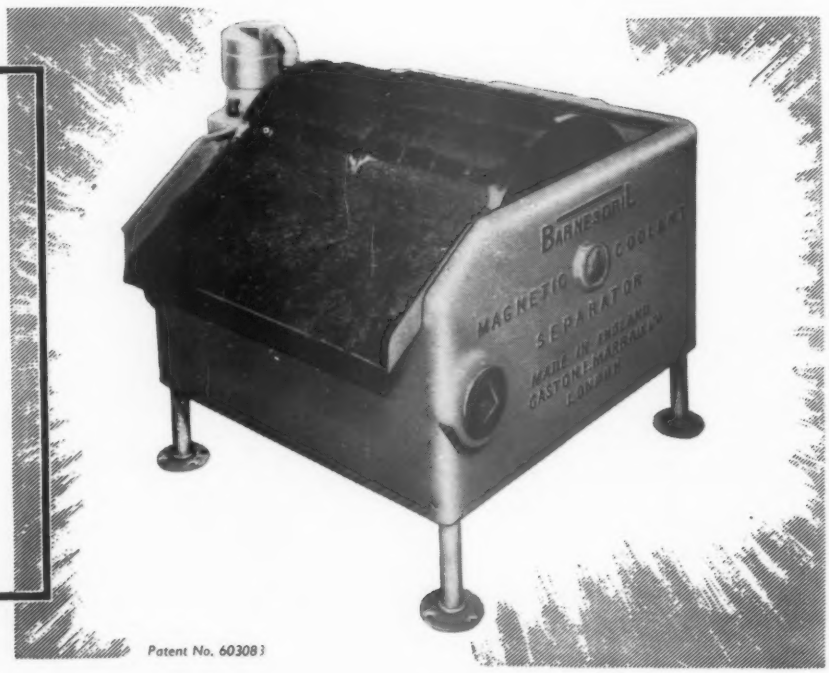
FOR UNUSUAL MACHINES

BARNESDRIL MAGNETIC

Automatic COOLANT SEPARATOR

MADE IN GREAT BRITAIN

Reduce machine maintenance, avoid machine shut-downs, improve machine finishes.



Patent No. 603083

CHECK THESE FEATURES

- Permanent ALCOMAX magnets ensure infinite life.
- Extra long magnetic field overcomes viscosity resistance on small particles.
- Approximately 275 square inches of magnetic drum surface in contact with loaded coolant.
- Counter rotation of magnetic drum removes non metallic particles.
- Interlocked magnetic field assures consistent attraction.

RANGE OF SIZES

Model No.	1	2	4	7	10
Capacity (Imp. Gals. per min.)	8	16	33	58	83

MODEL Nos. 7 & 10 READILY ADAPTABLE FOR BULK SERVICING OF GROUPS OF MACHINES. ONE FIRM FOR EXAMPLE, USES A "BATTERY" OF SIX No. 10. MODEL TO SERVE 165 MACHINES.

WRITE TO-DAY FOR FULL DETAILS.

GASTON E. MARBAIX LTD

DEVONSHIRE HOUSE, VICARAGE CRESCENT, BATTERSEA LONDON, S.W.11
PHONE BATTERSEA 8888 (8 lines)

A MARBAIX ANNOUNCEMENT

FAST!.. FASTER!.. —it's FASTERMATIC!

TURRET LATHES by GISHOLT

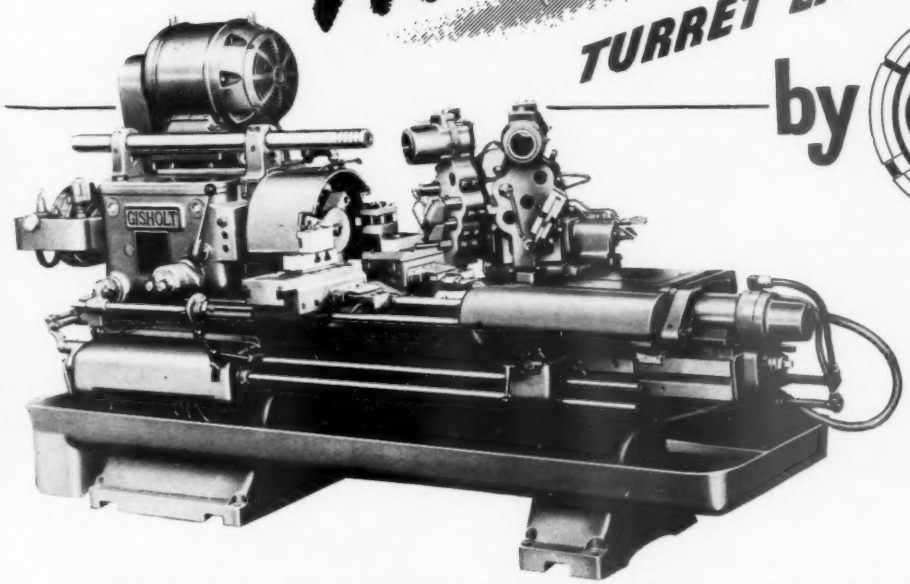


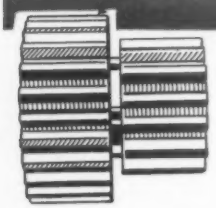
Illustration shows the 2-F Fastermatic—one of three sizes with swing over bedways ranging from 21" to 29".

For a wide variety of jobs, Fastermatic means speedier production and lower costs. Completely automatic, easy to set up, this machine continually repeats the tolerances to which it has been set. Each turret has rapid traverse and one or more feeds which can be automatically changed at any given point. The turret feeds to a positive dead stop for repeated accuracy and there is a wide variety of automatic spindle speed changes. One or more spindle speeds may be used for each turret station. The point of speed change is also adjustable. Manual operation during set-up is handled by hydraulic controls which permit the operator to advance, stop, back up or continue anywhere within the cycle.

WRITE FOR CATALOGUE

GASTON E. MARBAIX LTD

DEVONSHIRE HOUSE VICARAGE CRESCENT,
BATTERSEA LONDON S.W.11
PHONE BATTERSEA 8888 (8 lines)



FOR SPUR, SPIRAL & DOUBLE HELICAL GEARS THE 'SUNDERLAND' SYSTEM PROVIDES

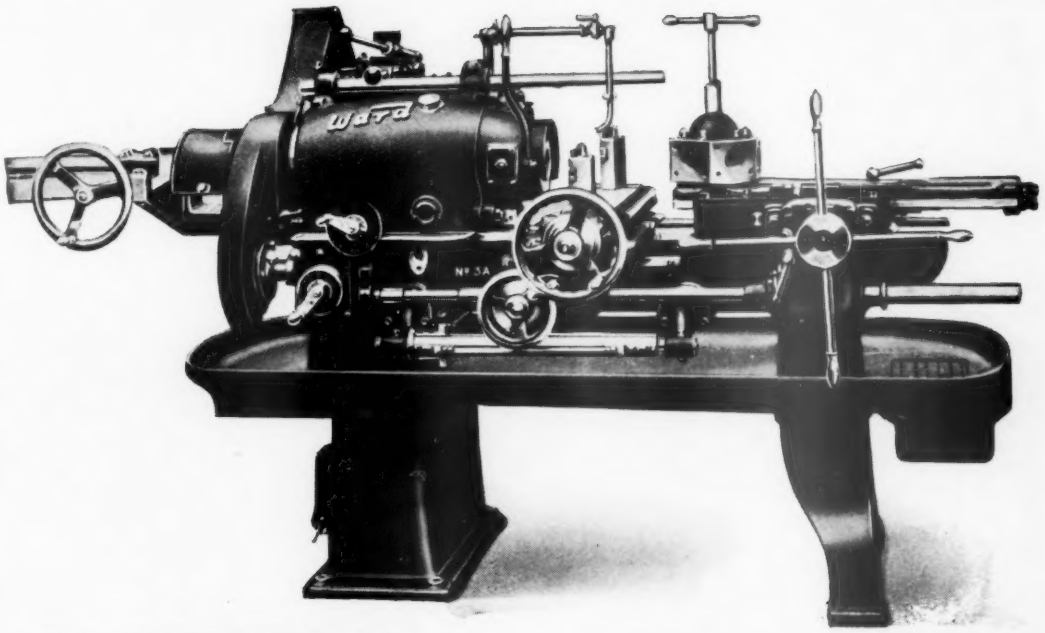
- EXTREME SIMPLICITY AND MATHEMATICAL ACCURACY.
- RAPID OUTPUT AND EXCELLENT QUALITY.
- FEW CUTTERS AND GREAT RANGE AND CAPACITY.
- ONE CUTTER CUTS ANY NUMBER OF TEETH OF A PITCH.
- LOW INITIAL OUTLAY ON CUTTERS.
- LOW COST OF MAINTENANCE.

J PARKINSON & SON (SHIPLEY) LTD

SHIPLEY TELEPHONE 53231 YORKSHIRE

P356A

For Maximum Production



Ward No. 3A CAPSTAN LATHE

Height of centres	...	6½in.
Spindle hole dia.	...	1¾in.
Auto. chuck will take dia.		1½in.
Swing over bed, max. dia.		13⅛in.
Swing over cross-slide	...	7 in.

Please write for particulars of our full range of Capstan & Turret Lathes

Ward machines are designed and built to get the best out of tungsten carbide, their metal removing capacity being limited only by the cutting tools used.

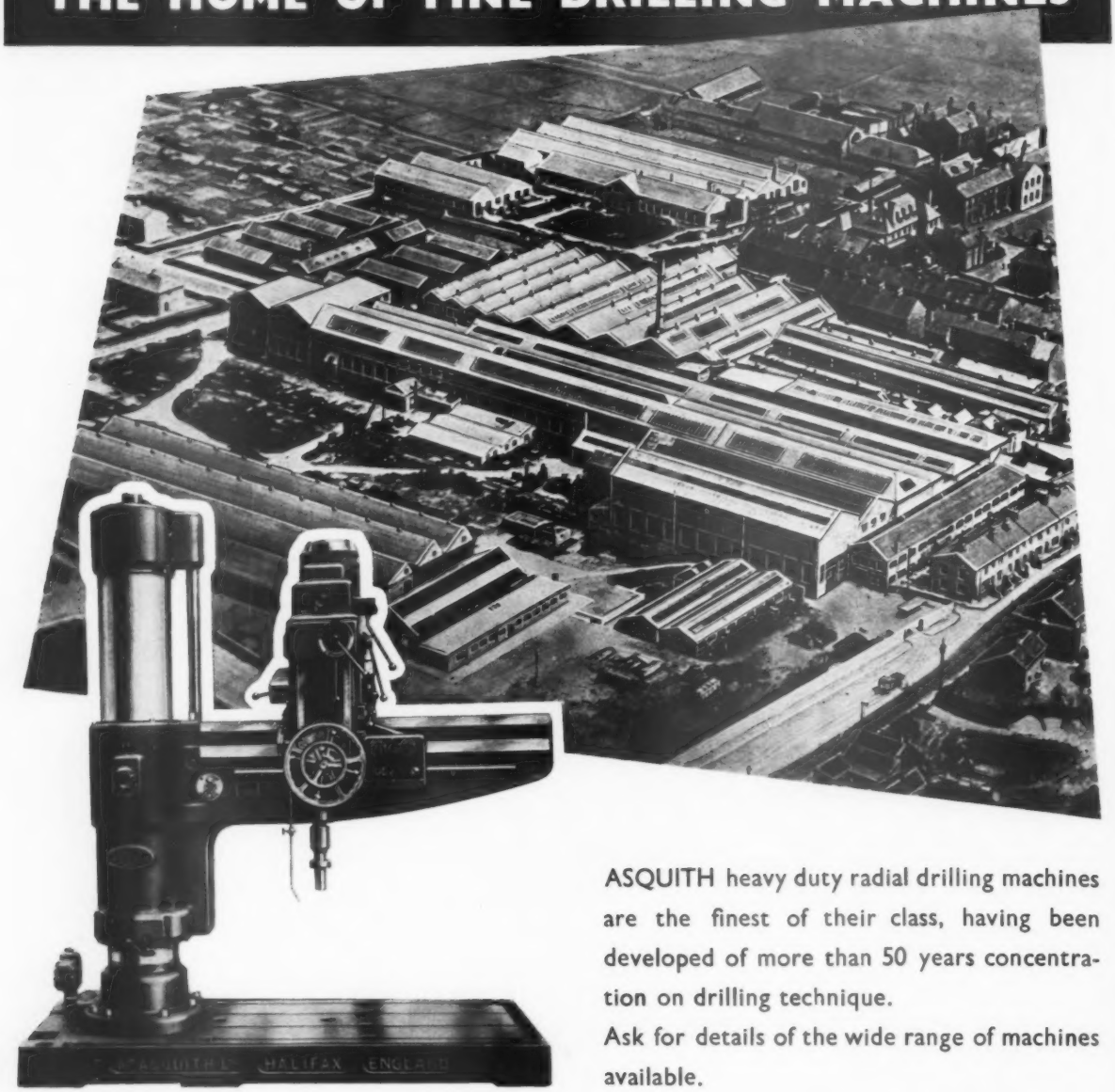
H.W. WARD & CO. LTD

SELLY OAK BIRMINGHAM 29

TELEPHONE SELLY OAK 1131

W 565

THE HOME OF FINE DRILLING MACHINES



ASQUITH heavy duty radial drilling machines are the finest of their class, having been developed of more than 50 years concentration on drilling technique.

Ask for details of the wide range of machines available.

The location of all controls at one point, is one of the outstanding features of the OD Radial Drills—it was the prime consideration of the designers in developing this highly successful machine, and has enabled users to cut considerably their cost per hole.

ASQUITH

WILLIAM ASQUITH LIMITED, HALIFAX, ENGLAND.

Sales and Service for the British Isles.

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW STREET, BIRMINGHAM.

Degreasing

THE MODERN WAY

A DAWSON Cleaner solves the problem of handling grease covered components without breaking the continuity of line production.
RESULT: more speedy handling on subsequent operations, no time lost for washing, improved standard of work.
There is a DAWSON machine for every need from accasional cleaning to full automatic washing, rinsing and drying.
The DAWSON catalogue, *sent on request*, shows many interesting installations. May we post you a copy?

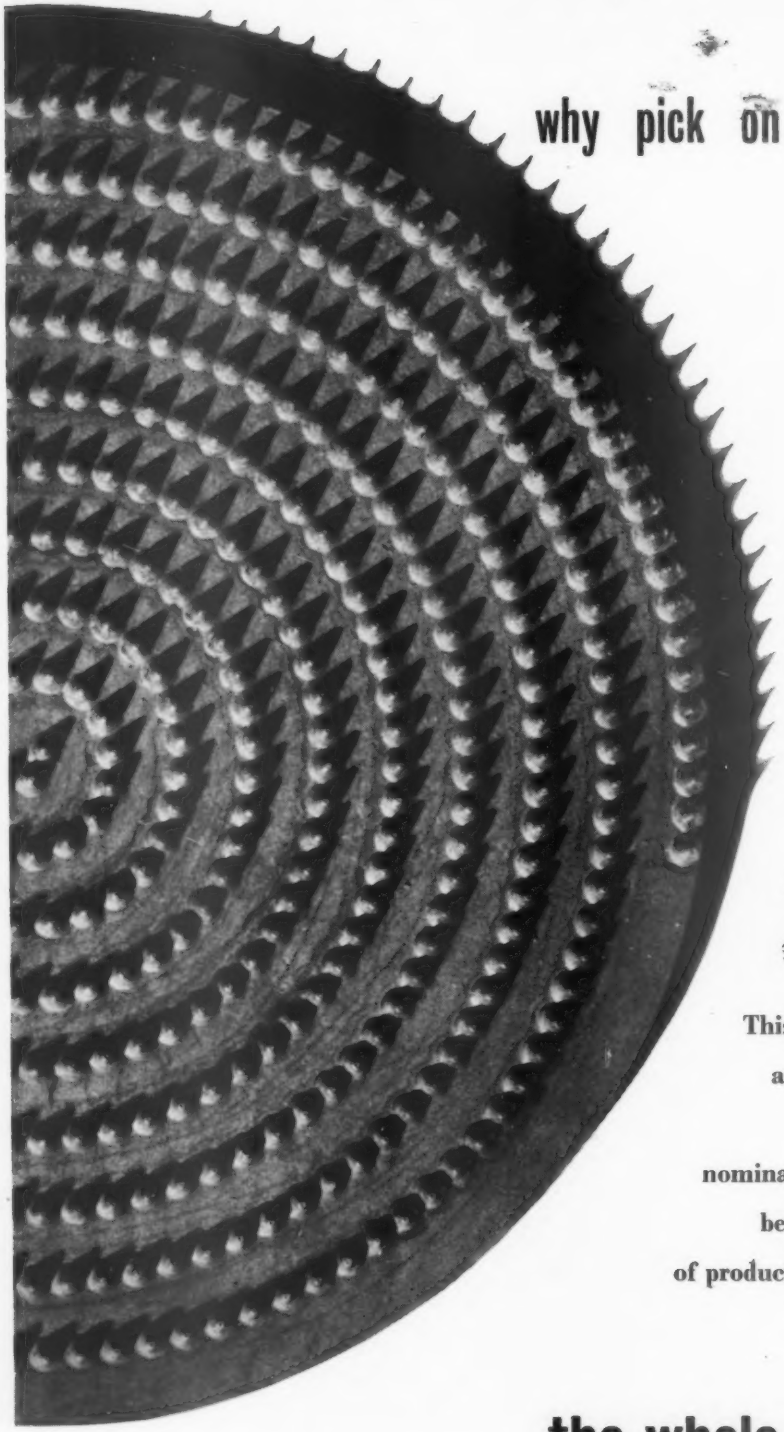
DAWSON
INDUSTRIAL
Metal Parts Cleaning Machines

Full particulars on request

Sales and Service for the British Isles

DRUMMOND-ASQUITH (SALES) LTD.
KING EDWARD HOUSE • NEW STREET • BIRMINGHAM
Phone: Midland 3431 (5 lines) Grams: Maxishape, Birmingham
ALSO AT LONDON & GLASGOW

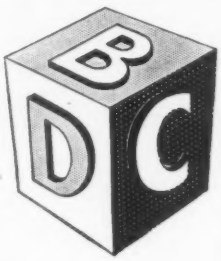
Anderson



why pick on us?

This part for a potentiometer has 540 accurate projections spaced equally within limits of ± ·001″ of nominal position. Can *you* think of any better way than pressure die casting of producing the whole *in one operation*?

the whole in one



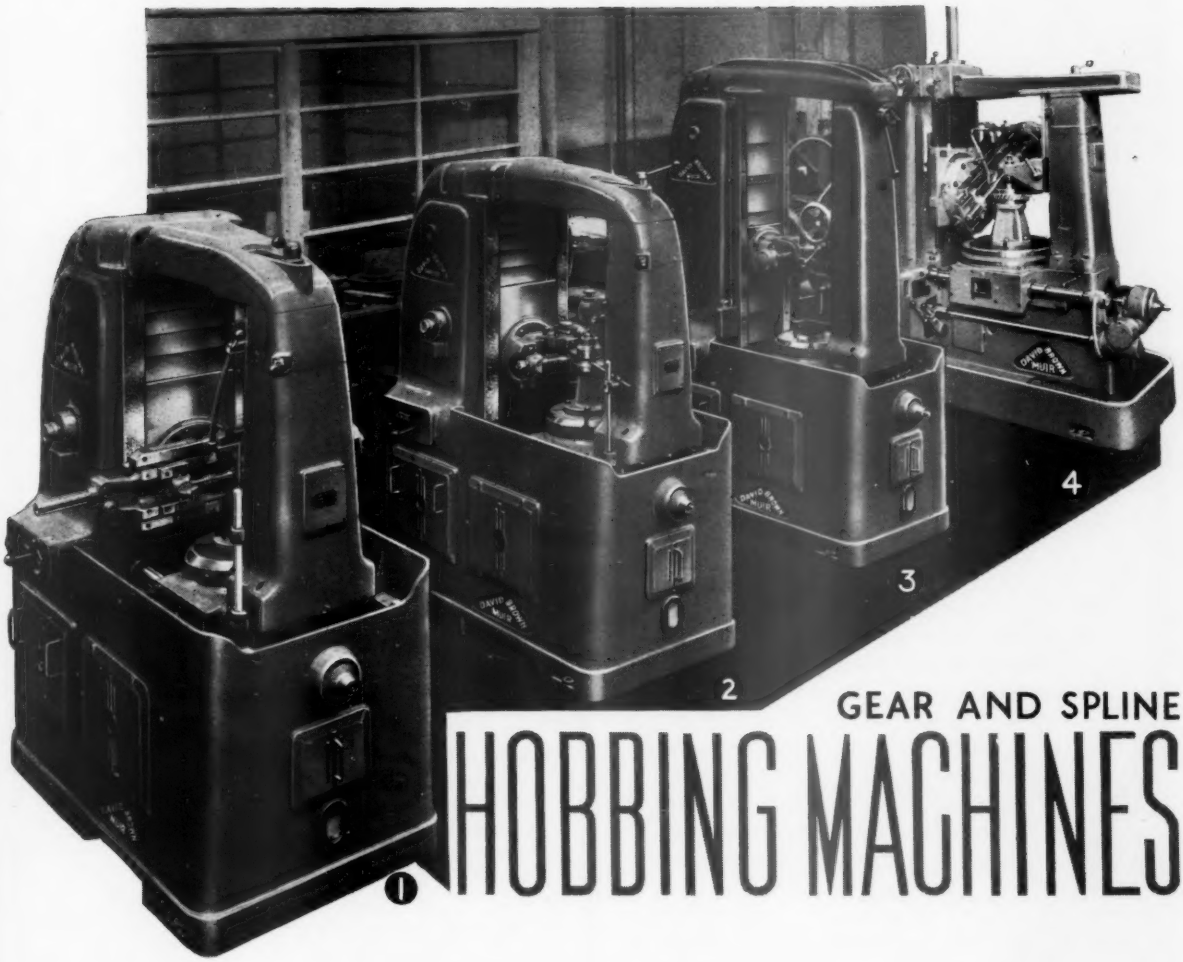
BRITISH DIE CASTING AND ENGINEERING COMPANY LTD.

Pembroke Works · Pembroke Road · London, N.10 · Telephone Tudor 2594-5-6

WEST CHIRTON TRADING ESTATE · NORTH SHIELDS · NORTHUMBERLAND · NORTH SHIELDS 2100

CRC 20

DAVID BROWN – MUIR



GEAR AND SPLINE HOBBING MACHINES

Greater production at lower cost means the installation of machines capable of sustained accuracy at high speeds. The David Brown-Muir Hobbing Machines are of this order and are ideal for the quantity production of precision spur and helical gears, splines and serrations. The four machines illustrated are the most popular of our smaller models whilst Hobbing and Shaving Machines up to 200 in. gear diameter can also be supplied. Attractive delivery dates can be arranged and our descriptive literature is available at your request.

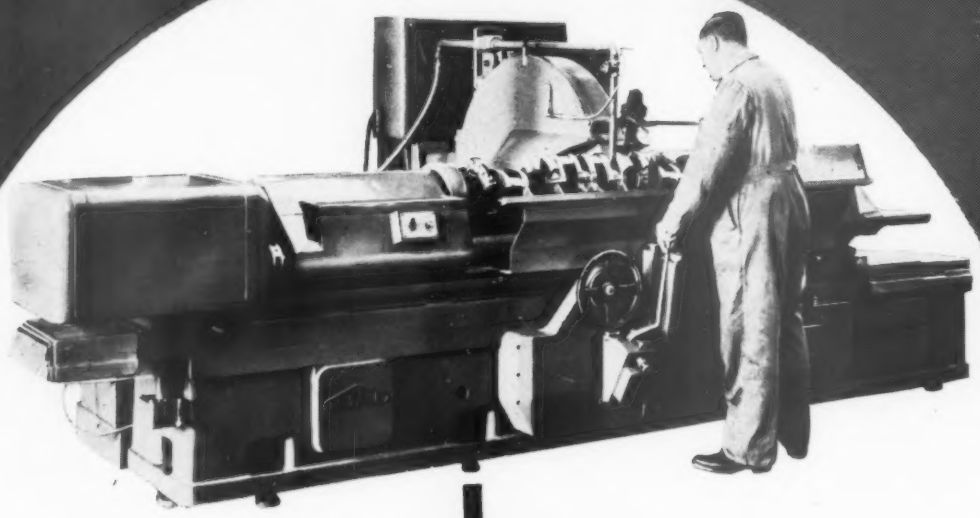
1. **M.T.15 Universal Gear Hobbing Machine.**
2. **M.T.15 Standard Gear Hobbing Machine.**
3. **M.T-V Spline Hobbing Machine.**
4. **M.T-30 Gear Hobbing Machine.**

A DAVID BROWN COMPANY

DAVID BROWN MACHINE TOOLS LTD

BRITANNIA WORKS, SHERBORNE ST., MANCHESTER 3

for greater economy in crankshaft production



The "HAC" Automatic Grinding machine is a massive, well designed tool providing ease of operation, high rates of production and extremely accurate product finishing. Made in three sizes each having a 16" swing, with a capacity of 48", 60" or 72". Each machine has a fully automatic grinding cycle by electrical and hydraulic power. There is a 5" rapid wheelhead approach with four automatic variable infeed rates. Wheelhead bearings, wheelhead slides, etc., are supplied with automatic lubrication, and there is a drip feed system to the driving chain.

SPECIFICATION

Maximum length between faces of workheads	48"-60"-72"
Minimum length between faces of workheads	30"-42"-54"
Work centre height	10"
Maximum diameter of new wheel	42"
H.P. of wheelhead motor	20
R.P.M. of wheelhead motor	1,000
H.P. of hydraulic motor	2
R.P.M. of hydraulic motor	1,500
H.P. of workhead motor	3
R.P.M. of workhead motor	960
Starters	Automatic type housed in separate control cabinet
Table speed	Infinitely variable from 3"-180" per minute
Plunge cut feed	Infinitely variable
Quick run back of wheelhead	5"

send for full details and specification to—

NEWALL GROUP SALES LTD

PETERBOROUGH SCOTLAND Phone Peterborough 2227-8-9

NEWALL

HAC AUTOMATIC CRANKPIN GRINDER

Scottish Agents: Drummond-Asquith Ltd., 175 West George Street, Glasgow, C.2.

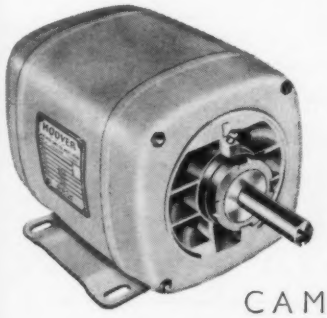
P2488

THE POWER OF A NAME

WHEN a man is famous enough the mention of his name calls up an instant impression of his face and character. In certain cases mere initials can do the same. The letters 'W.G.' certainly suggest the impressive appearance and famous achievements of the most renowned cricketer of all time. Linked with the name Hoover, the initials 'F.H.P.' have a similar power. To manufacturers everywhere they represent a fractional horse power motor that is unsurpassed for efficiency and quality, that will give the same smooth service for the whole of its long life. These manufacturers have *proved* that the name Hoover F.H.P. represents the world's finest 'fractional' — with the world's finest service plan to back it.

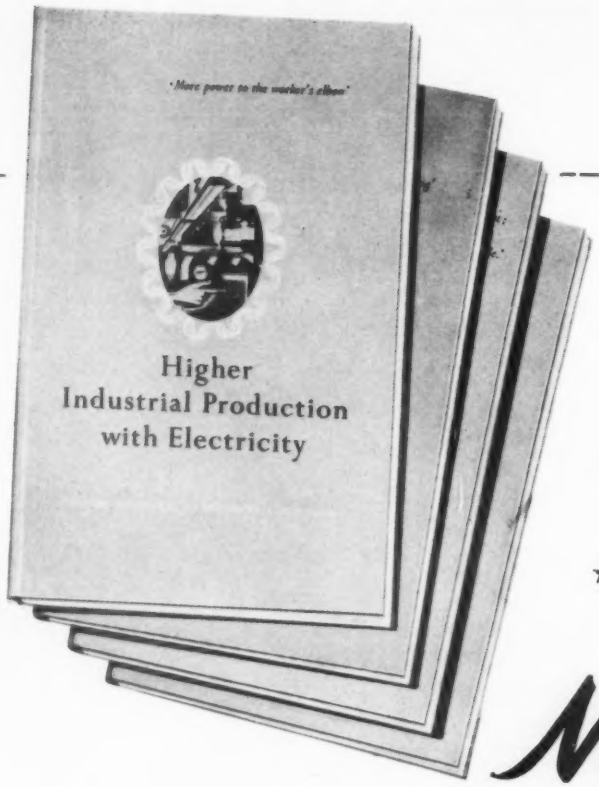
The Hoover F.H.P. Motor combines superb quality with competitive price. Please write for name and address of your nearest distributor.

HOOVER LIMITED



INDUSTRIAL PRODUCTS DEPARTMENT

CAMBUSLANG · LANARKSHIRE · SCOTLAND



★ "HIGHER INDUSTRIAL PRODUCTION WITH ELECTRICITY"

★ "LIGHTING IN INDUSTRY"

★ "MATERIALS HANDLING IN INDUSTRY"

★ "ELECTRIC RESISTANCE HEATING"

New BOOKS ON

Industrial Productivity

PRODUCTIVITY is one of the vital problems affecting Britain today. One way to increase productivity is to put POWER at a man's disposal; and the best way to do this is with electricity.

As a contribution to the solution of this problem, the British Electrical Development Association is now publishing a new series of books for management and executives in Industry. The first four are now available: "Higher Industrial Production with Electricity" describes a wide variety of modern production methods; "Lighting in Industry" shows how lighting can affect individual output, how its effectiveness can be assessed, and how improvements can be made; "Materials Handling in Industry" shows the way to increased productivity by improved handling; and "Electric Resistance Heating" indicates where, and how, this unique method of producing heat without combustion can be applied.

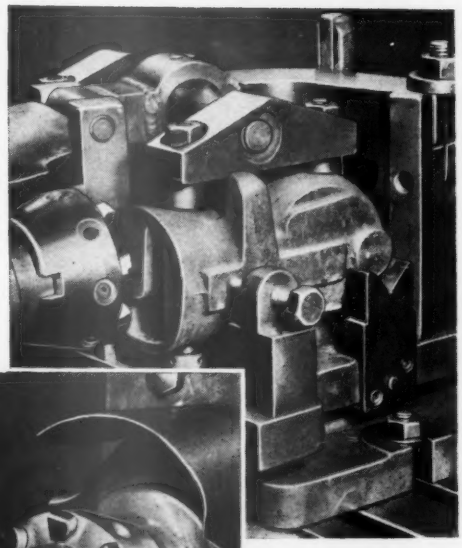
The post-free price of each of the books is 9/- and copies can be obtained from the British Electrical Development Association, 2 Savoy Hill, London, W.C.2, or from your Electricity Board.

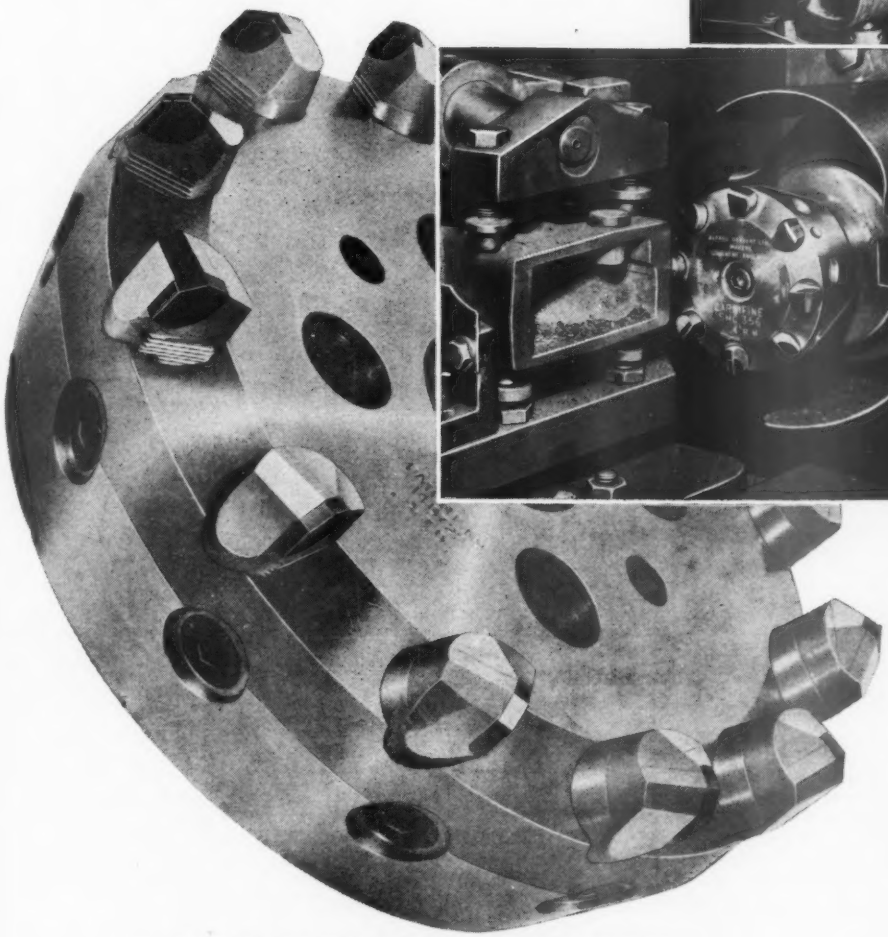
The Association has produced a film called "A Case for Handling" which illustrates by practical demonstration the vital part that improved materials handling can play in all industries. It runs for 32 minutes, and is available on free loan.

Electricity *for* PRODUCTIVITY

Supreme for Face Milling Operations

THE HERBERT
HIGH-POWER CARBIFACE *AND* CARBIFINE CUTTERS TIPPED *WITH* ARDOLOY





HIGH-POWER CARBIFACE. For use on medium to high-powered machines for machining steels and cast-iron.
Eleven sizes—3″ to 16″ dia.
CARBIFINE. For light cuts on cast-iron and non-ferrous materials. High degree of surface finish on interrupted surfaces.
Eleven sizes—3″ to 16″ dia.
Other types available for specific operations on various materials.

- POSITIVE TOOTH LOCKING ARRANGEMENT. THE TEETH CANNOT MOVE EVEN UNDER TEST CONDITIONS
- TEETH WITH DIFFERENT RAKE ANGLES CAN BE FITTED IN THE SAME CUTTER BODY. UNBROKEN RING OF METAL OUTSIDE TOOTH HOLES.

Full details from Ardoloy Sales Department, Head Works. 'Phone: 88781—Ext. 26.

ALFRED HERBERT LTD · COVENTRY

BIRLEC

gas carburising

in standardised Birlec pit furnaces

* *This photograph was taken in the heat treatment shop of a leading manufacturer of bearings.*

STANDARD PIT FURNACES

Furnace Rating	Usable Dimensions	
	Diameter	Depth
1,800 c.f.h.	2′ 6″	4′ 0″
2,800 c.f.h.	3′ 6″	5′ 0″

The larger sizes of Birlec pit gas carburising furnaces are heated by "U" shaped gas-fired radiant tubes, arranged around the periphery of the charge space. No furnace muffle is, of course, required and the tubes have a long life. The gas carburising atmosphere may be derived either from processed town's gas or an inexpensive fluid.

About fifty standardised gas or electric Birlec gas carburising furnaces are now installed or on order. They enable gas carburising to be carried out under production conditions with assured, reproducible results. If you are manufacturing engine or transmission components, you will be interested. May we send details?

BIRLEC LIMITED

ERDINGTON · BIRMINGHAM · 24

BIRLEC

SM/B. 736a

Sales and service offices in LONDON · SHEFFIELD · GLASGOW

production control . . .

needs the *rapid* accumulation and co-ordination of detailed information about materials and processes. There is no better or faster means of compiling and presenting detailed information than that afforded by the Powers-Samas Punched Card System. Ask for more information from

POWERS-SAMAS

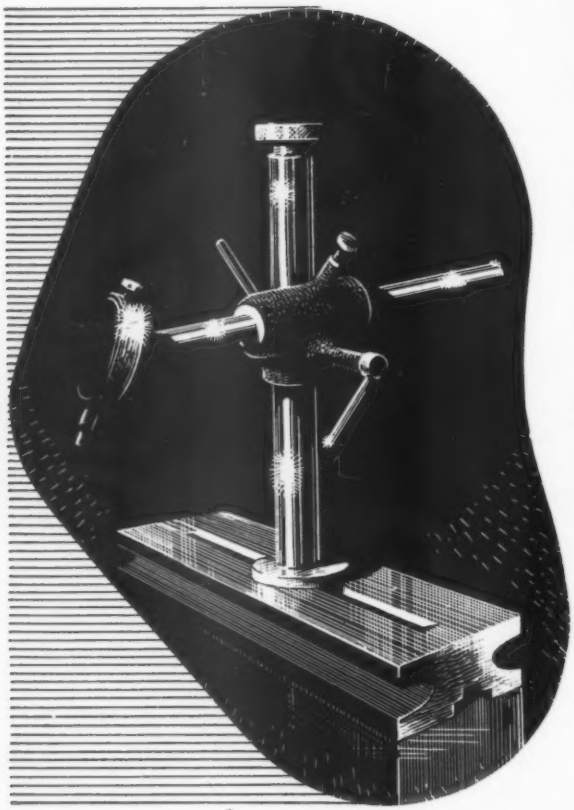
Powers-Samas Accounting Machines (Sales) Ltd. Powers-Samas House, Holborn Bars, London, E.C.1

We welcome your enquiries

FOR ALL KINDS OF

JIGS · FIXTURES & GAUGES

PRESS TOOLS · MOULDS AND SPECIAL PURPOSE MACHINES



Our commitments are heavy but we welcome an opportunity to study your requirements for inclusion in our production programme where possible.

Up-to-date shops specially laid out and equipped for making, on a production basis, every type of precision ground gauges; limit snap, form, calliper, taper and special purpose gauge, as well as jigs and fixtures of all kinds, press tools moulds and special purpose machines. Highest class workmanship and accuracy guaranteed.

Guaranteed
Precision
Accuracy

G.P.A.

G.P.A. TOOLS & GAUGES LIMITED

HARPER ROAD · WYTHENSHAWE · MANCHESTER

'Phone:- **WYTHENSHAWE 2215**

'Grams:- **PNEUTOOLS, PHONE**

HOLLERITH REGD.

MACHINES AND METHODS

applied to

PRODUCTION CONTROL

afford an easy-to-operate system which:

- **clearly defines programmes and correlates production to delivery dates**
- **gives immediate warning of hidden weaknesses or causes for hold-ups**
- **accurately controls and shows day-to-day stocks, material shortages and current position with bought-out materials**
- **effectively determines and controls machine and assembly shop loads**
- **keeps under constant review plant and labour capacities.**

HOLLERITH REGD. *Electrical* PUNCHED CARD ACCOUNTING

For further particulars, write or telephone:

THE BRITISH TABULATING MACHINE COMPANY LTD

Head Office: 17 Park Lane, London, W.1 · *Telephone:* Regent 8155

Branches in all principal cities in Great Britain and Oversea

JPE/532/116

"BROOMWADE" is best, Master Bonniface!

No, no; not "oom-pah, oom-pah". It should be "oom-pah-pah-*PAH!*" After all those lessons, too! No more blow, you say? There's *another* way of compressing air, Master Bonniface; the "BROOMWADE" way. "BROOMWADE" Air Compressors operate pneumatic tools to drill, pump, rivet, grind, ram, fettle, bore, hoist, spray, chip, scrub, polish, caulk, shear, tamp . . . (Now we're as much out of breath as you are, Master Bonniface).

"Broomwade"

Air Compressors and Pneumatic Tools are used in most Industries

Send your enquiries to BROOM & WADE LTD., DEPT. 10 HIGH WYCOMBE, ENGLAND

121 S.A.S.

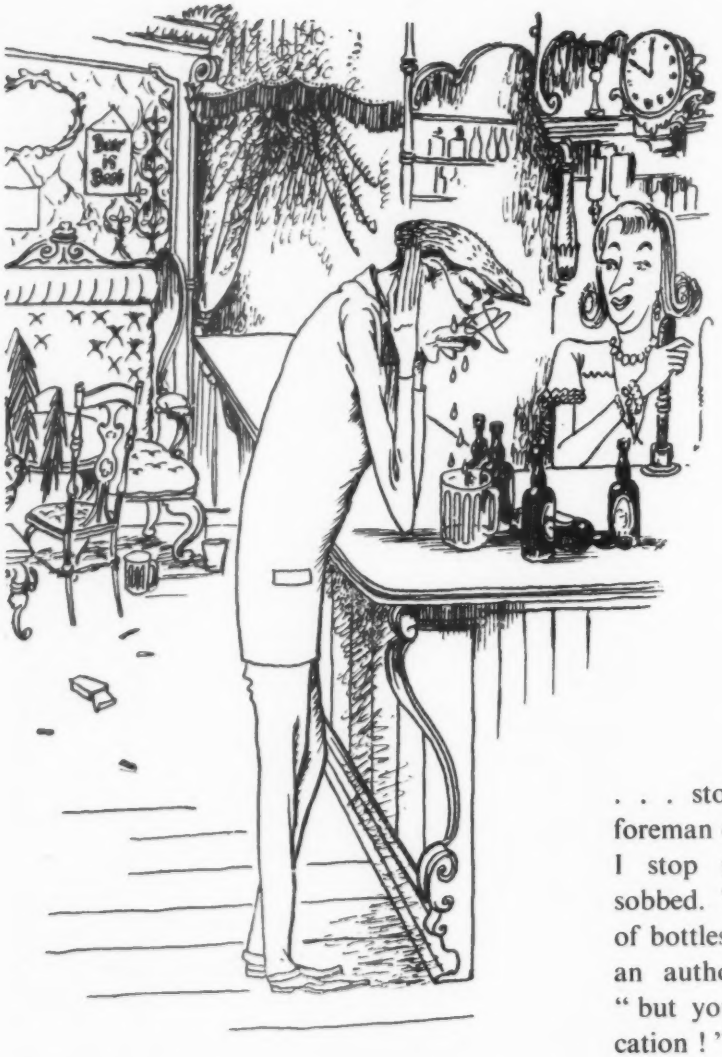
TOOL STEELS

Firth Brown High Speed Steel, Alloy Tool Steels and Carbon Tool Steels are recognised throughout the world as giving optimum service.

The illustration shows a Blanking Die and Taps made from either Firth Brown "NONVAR" or "TMS" tool and die steels.

by FIRTH BROWN

Issued by Thos Firth & John Brown Ltd. Sheffield.



A boring bar in need of lubrication . . .

. . . stood deserted save for the machine shop foreman crying into his empty glass. "How can I stop my machines breaking down?" he sobbed. The barmaid glumly surveyed the row of bottles he had emptied. "You may not be an authority on machinery," she observed, "but you are certainly an authority on lubrication!" A wild light of hope appeared in the foreman's eye. "That's it," he shouted, "authority on lubrication . . . Tecalemit . . . AUTOMATIC LUBRICATION!" He fled from the room. "Well," complained the barmaid, "perhaps, in future, he'll have the grease to say goodbye!"

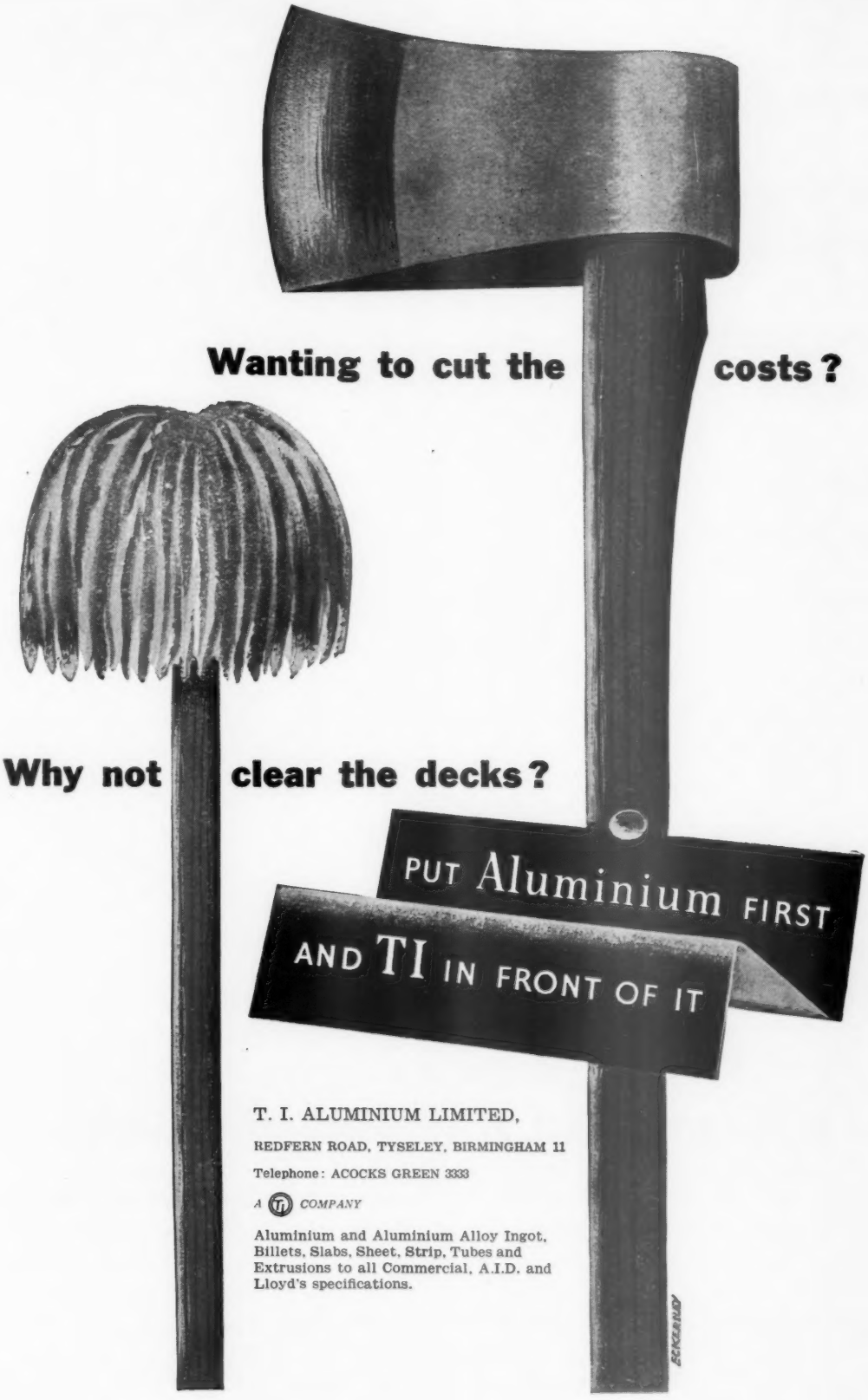
Tecalemit lubrication systems—fully automatic, semi-automatic or manually operated — feed every bearing with the correct amount of oil or grease at the correct intervals of time, regularly . . . unfailingly . . . efficiently. A Tecalemit engineer will gladly call to discuss your particular lubricating problems with you.

TECALEMIT

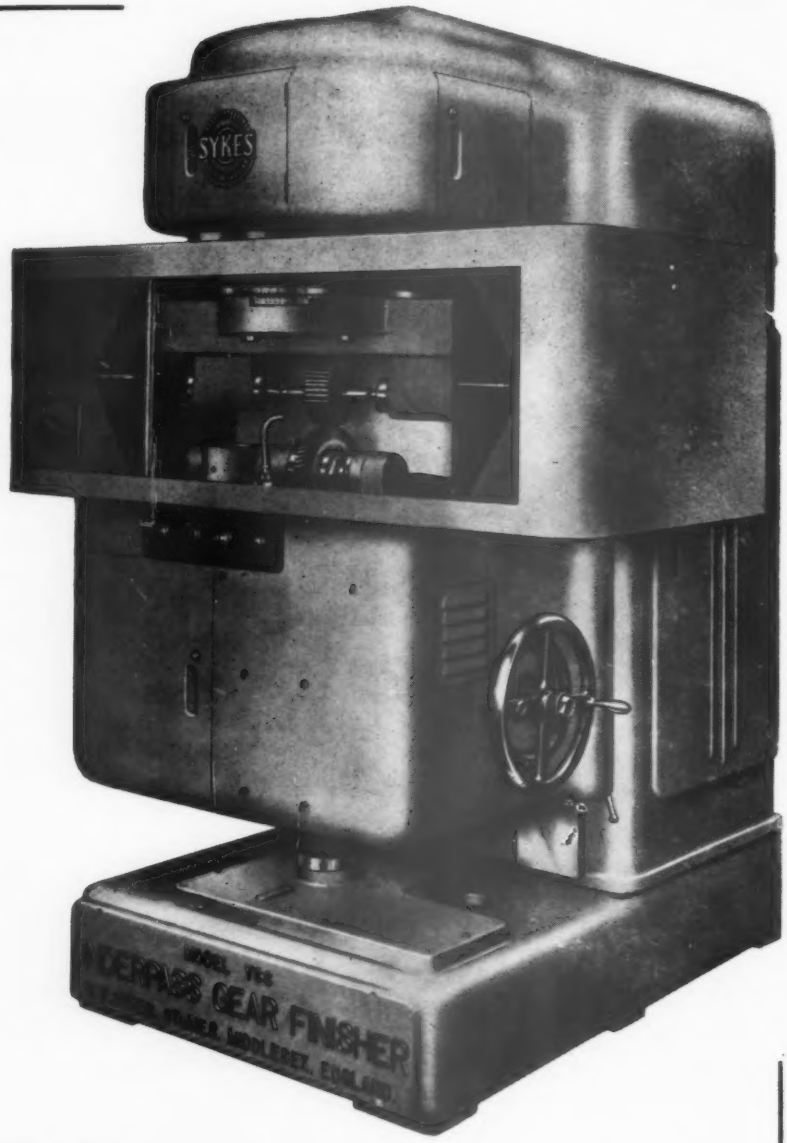
The Authority on Lubrication

PLYMOUTH, ENGLAND

T404


Wanting to cut the costs?
Why not clear the decks?
PUT Aluminium FIRST
AND TI IN FRONT OF IT
T. I. ALUMINIUM LIMITED,
REDFERN ROAD, TYSELEY, BIRMINGHAM 11
Telephone: ACOCKS GREEN 3333
A TI COMPANY
Aluminium and Aluminium Alloy Ingot, Billets, Slabs, Sheet, Strip, Tubes and Extrusions to all Commercial, A.I.D. and Lloyd's specifications.

- ***Better finish***
- ***Greater accuracy***
- ***Increased output***
- ***Lower production costs***



SYKES

VS.8 UNIVERSAL *UNDERPASS* ROTARY GEAR FINISHING MACHINES

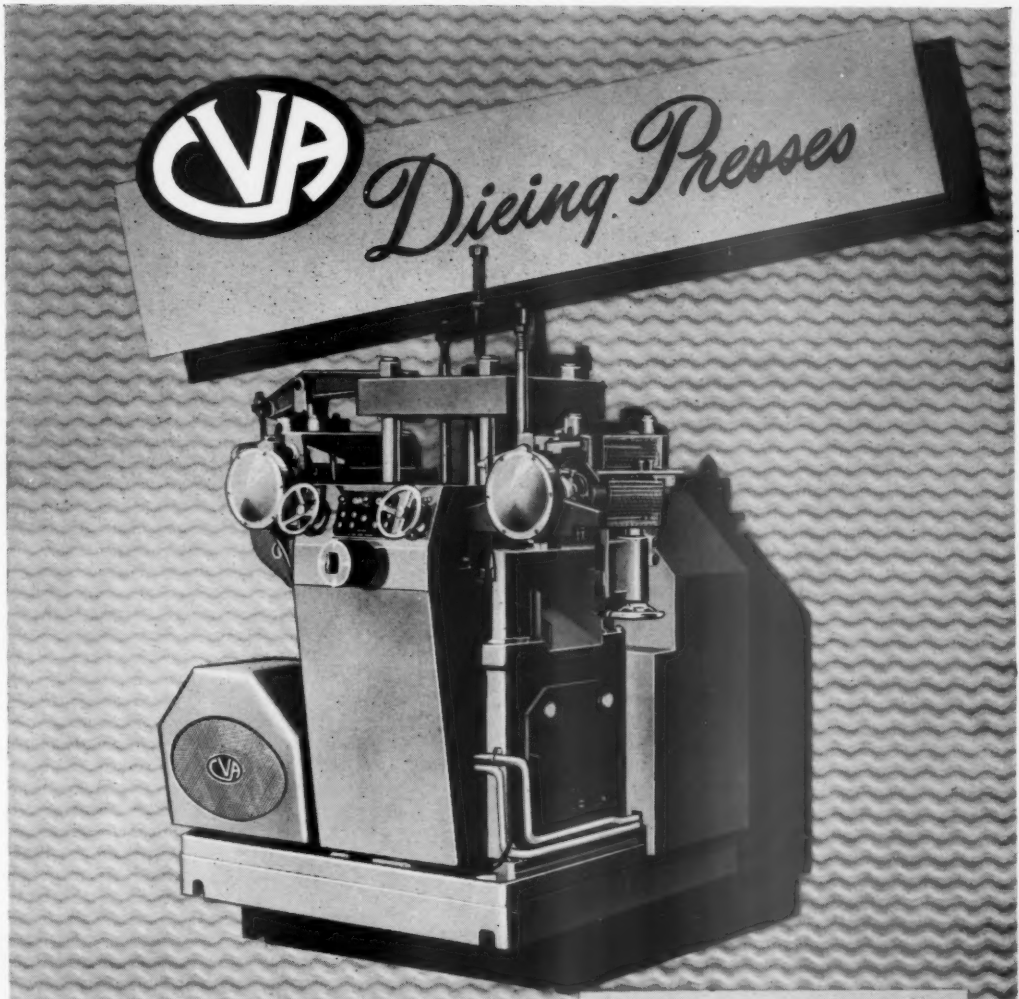
CAPACITIES 1" to 8"
1" to 12"
1" to 18"
MAX. FACE WIDTH 5"

Full technical data on request

W · E · SYKES LIMITED

STAINES · MIDDLESEX · ENGLAND

Telephone: Staines 4281 *Telegrams: "Sykutter, Staines"*



Range of 10, 25 and 50 ton Models. Let our Technical Representatives examine your applications.

E. H. JONES
(MACHINE TOOLS) LTD

GARANTOOLS HOUSE, PORTSLADE
BRIGHTON - - - SUSSEX
Telephone: HOVE 47253 Telegrams: Garantools, Portslade

LONDON BIRMINGHAM · EDINBURGH · MANCHESTER · BRISTOL

Rathbone

THE ZINC ALLOY DIE CASTERS ASSOCIATION includes all the leading zinc alloy die casters in the U.K. The Association and its Members welcome all enquiries on the properties, design and application of the castings. Problems are submitted anonymously to the experts on its Technical Committee whose verdict is impartial. A list of publications will be sent on request. Enquiries regarding the supply of castings should be sent to Members whose names are given below. The Association is a non-trading body and is in no way concerned with any questions of price.

FULL MEMBERS Firms mainly engaged in the production of castings for general sale.

ADVANCED PRESSURE DIE-CASTING CO. LTD., BIRMINGHAM.
ALLOY PRESSURE DIE PRODUCTS LTD., WILLENHALL.
THOMAS ASHWORTH & CO. LTD., BURNLEY.
AVON DIECASTING CO. LTD., BIRMINGHAM.
BIRMINGHAM ALUMINIUM CASTING (1903) CO. LTD., BIRMINGHAM.
BRITISH DIE CASTING & ENG. CO. LTD., LONDON.
CHASE NON-FERROUS METAL CO. LTD., ENFIELD.
DIE CASTING MACHINE TOOLS LTD., LONDON.
DYSON & CO. ENFIELD (1919) LTD., ENFIELD.
FRY'S DIECASTINGS LTD., LONDON.
GILLS PRESSURE CASTINGS, BIRMINGHAM.
JOHN IRELAND (WOLVERHAMPTON) LTD., WOLVERHAMPTON.
JACKSON, HEYWOOD & CO LTD., WHITEFIELD, nr. MANCHESTER.
KAYE ALLOY CASTINGS LTD., BIRMINGHAM.
METAL CASTINGS LTD., WORCESTER.
ORB ENGINEERING WORKS LTD., MANCHESTER.
PATENT DIE-CASTINGS CO. LTD., LONDON.
SPARKLETS LTD., LONDON.
STREBOR DIECASTING CO. LTD., RADCLIFFE, LANCS.
UNIVERSAL ENGINEERING CO., NOTTINGHAM.
WESTERN DIECASTING LTD., BRISTOL 5.
WOLVERHAMPTON DIE-CASTING CO. LTD., WOLVERHAMPTON.

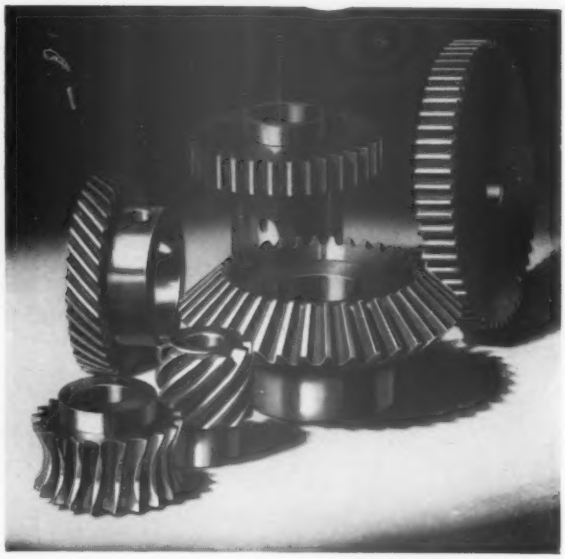
ASSOCIATE MEMBERS Firms mainly engaged in the production of castings for use in their own products.

ACME WRINGERS LTD., GLASGOW.
AC-SPHINX SPARK PLUG CO., DUNSTABLE.
ARMSTRONG'S PATENTS CO. LTD., BEVERLEY, YORKSHIRE.
W. & T. AVERY LTD., BIRMINGHAM.
BLETCHLEY ENGINEERING CO. LTD., SLOUGH.
BRITISH THOMSON-HOUSTON CO. LTD., BIRMINGHAM.
WM. COULTHARD & CO. LTD., CARLISLE.
EVERED & CO. LTD., SMETHWICK.
CHARLES HILL & CO. LTD., BIRMINGHAM.
INGALL, PARSONS, CLIVE & CO. LTD., BIRMINGHAM.
ARCHIBALD KENRICK & SONS LTD., WEST BROMWICH.
LAN-BAR LTD., BIRMINGHAM.
JOSEPH LUCAS LTD, BIRMINGHAM.
MECCANO LTD., LIVERPOOL.
METTOY CO. LTD., NORTHAMPTON.
PHILLIPS & CROSS LTD., BIRMINGHAM.
RAWLINGS MANUFACTURING CO. LTD., LONDON.
SHAW FOUNDRY CO., WILLENHALL.
STANMORE ENGINEERING CO. LTD., STANMORE, MIDDLESEX.
T. A. L. DEVELOPMENTS LTD., LONDON.
WITHERS (WALSALL) LTD., WALSALL.
YALE & TOWNE MANUFACTURING CO., WILLENHALL.

ZADCA

ZINC ALLOY DIE CASTERS ASSOCIATION

Lincoln House, Turl Street, Oxford. Telephone Oxford 48088



For parts like these specify

McKECHNIE

Manganese Bronze

or H.T. Brass

Because of their great strength, good resistance to corrosion and easy machining, more and more manufacturers are specifying McKechnie manganese bronzes and high tensile brasses. McKechnie Metal Technique has helped to solve many manufacturing and machining problems. Perhaps it can help to solve yours? *Write to McKechnie Brothers Ltd., 14, Berkeley Street, London, W.1.*

McKECHNIE metal technique

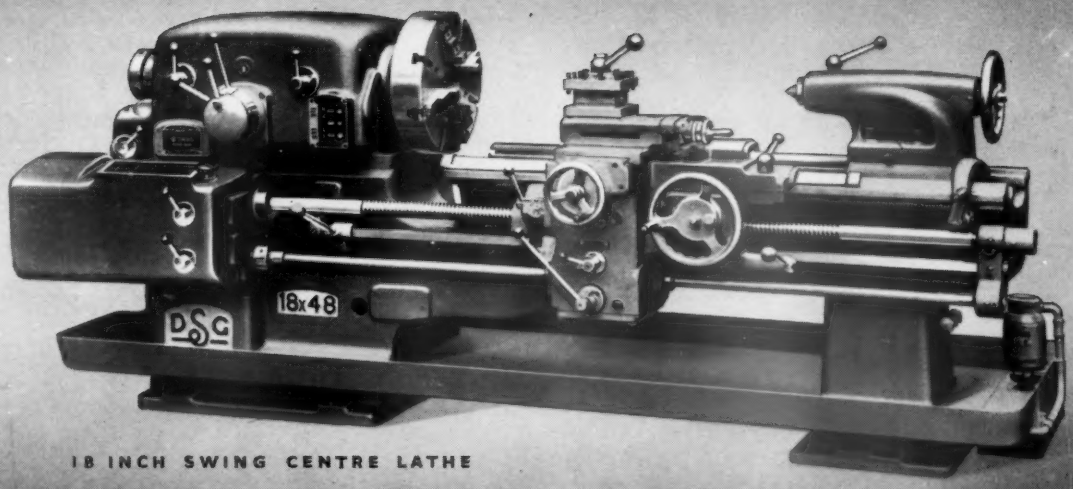
★ *See our Exhibit at The London Building Centre, Store Street London W.1.*

McKECHNIE BROTHERS LIMITED

Metal Works: Rotton Park Street, Birmingham, 16. *Branch Offices:* London, Leeds, Manchester, Newcastle-on-Tyne, Gloucester. *Solder Works:* Stratford, London, E.15. *Copper Sulphate and Lithopone Works:* Widnes, Lancs. *Enquiries for Lithopone and Solder to:* 14 Berkeley Street, London, W.1. *South African Works:* McKechnie Brothers S.A. (Pty) Ltd., P.O. Box No. 382, Germiston, S.A. *New Zealand Works:* McKechnie Brothers (N.Z.) Ltd., Carrington Road, New Plymouth.

DSG

internationally demanded for precision and reliability.....

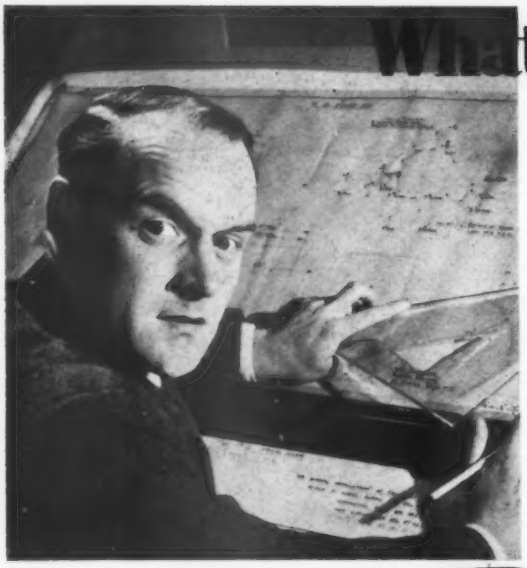


18 INCH SWING CENTRE LATHE

1865 **Dean Smith & Grace** 1953

KEIGHLEY LIMITED ENGLAND

DESCRIPTIVE CATALOGUE WILL BE SENT ON REQUEST



What's your problem?

Insulation? Protection? Silencing? Sealing?

Simple or complex, Redfern's will help to solve it. We have the experience, capacity and resources for economical bulk production of moulded components and extruded sections in natural and synthetic rubbers, and ebonite. Plan with all the knowledge of our technical staff at your elbow — we are always pleased to advise on the use of these versatile materials, and translate designers' ideas into terms of efficient production. Send us your enquiries—we will do the rest!

Literature is available describing our service — MOULDINGS . . . EXTRUDINGS . . . anti-corrosive LININGS & COVERINGS . . . FLOW FITTINGS (piping, cocks, tees, etc.,) . . . chemical-resisting UTENSILS . . . FABRICATED PARTS to specification.

A request to add your name to our mailing list will keep you up-to-date with publications dealing with any of these items.

MOULDINGS — EXTRUDINGS — FABRICATED PARTS AND UTENSILS

REDFERN

RUBBER & EBONITE

WILL HELP YOU SOLVE IT!

REDFERN'S RUBBER WORKS LTD · HYDE · CHESHIRE

T.P.312

Lorch

LATHES

$2\frac{1}{2}$", 4", $4\frac{3}{4}$" & 6"

CENTRE HEIGHTS

TOOLMAKERS LATHES • **SCREW-CUTTING LATHES**

Quick Delivery

SECOND OPERATION LATHES

Some Machines in Stock

For full details write to the main distributors

ADAM *Machine Tool Company Limited*

4, GRANGE STREET · ST. ALBANS · HERTFORDSHIRE

Telephone: St. Albans 6731/2 & 2131 Telegrams: Adamatic St. Albans

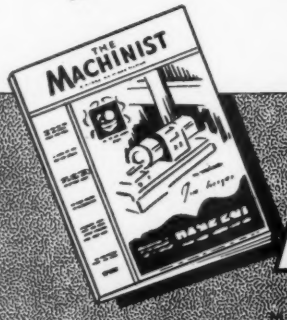
There's money in

PRODUCTION METHODS
TOOLING TECHNIQUES
MATERIALS HANDLING
ENGINEERING DESIGN
INSPECTION PRACTICE
MANAGEMENT . . . . . .

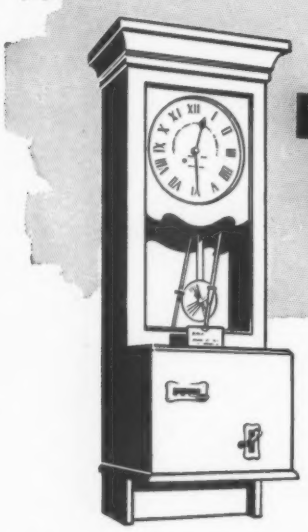
MONEY to be made and costs to be cut by implementing new production methods, techniques and designs introduced each week in The Machinist. The Machinist makes a service of news—news that is going to help you and your company to progress in the field of production engineering.
Keep abreast of current developments and order your copy TODAY.

Published in London since 1900.

★



THE MACHINIST
A BRITISH McGRAW-HILL PUBLICATION
McGRAW-HILL HOUSE, 95 FARRINGDON STREET, LONDON, E.C.4



TIME is MONEY

The Gledhill-Brook Company was intimate with the early problems associated with the design and production of time recording machines, and was first in producing efficient electric impulse recorders with accurate timekeeping free from dependence on electric frequency or external influence. Wages and cost methods have a time basic—that is where we are concerned to help. A large number of time recording models is now available covering most of the known needs for wages and labour cost control. One of industry's immediate needs is the reduction of waste—the waste of time that costs money.

GLEDHILL-BROOK TIME RECORDERS LIMITED

20 EMPIRE WORKS HUDDERSFIELD

---

better use - **HARRIS** *Tools*

GROUND THREAD & CUT THREAD
TAPS & DIES

GAUGES

JOHN HARRIS TOOLS LTD., WARWICK, phone: 741 (4 lines)

CUT MACHINING COSTS

with

Our DIECAST Iron Bar has been introduced to meet the very real need to cut machining costs. It is particularly suitable for the production of Bushes, Pump Rotors and Rams, Cams, Couplings, Sprockets and Gears of many types. Free from blow holes and inclusions the possibility of rejects after machining is materially reduced. Supplied rough turned in diameters from 3 in. to 6½ in. and lengths from 18 in. to 24 in.

"FLOWCAST" Cast Iron Bar from ¾ in. to 2¾ in. diameter and in lengths up to 8 ft., supplied centreless ground, can be used on Automatic Bar Machines with further reductions in machining costs.

Write for details and technical data to:—

HAROLD ANDREWS GRINDING CO., LTD.

BRISTOL ROAD, BOURNBROOK, BIRMINGHAM, 29.

Telephone: SELly Oak 1128-9-0, and at MANOR WORKS, MANOR LANE, HALESOWEN. Telephone: Halesowen 1181-2

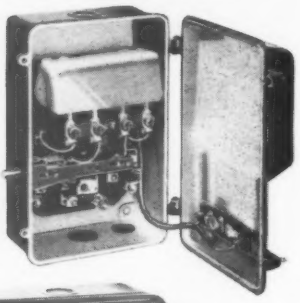
1	GUARANTEED SOUND RIGHT THROUGH — FREE FROM BLOW HOLES & INCLUSIONS.	✓
2	CLOSE GRAINED, i.e., IT TAKES A GOOD FINISH.	✓
3	FREELY MACHINABLE	✓
4	GREATLY REDUCED MACHINING COSTS. DIE CAST BARS SUPPLIED ROUGH MACHINED AND 'FLOWCAST' BARS CENTRELESS GROUND.	✓
5	COMPETITIVE IN PRICE.	✓

OUTSTANDING FEATURES

In Donovan A.C. Starter Design

TYPE A.30 SIZE 1.

- ★ Operation from pushbutton in lid, or elsewhere.
- ★ Tests show mechanically-stressed parts good for a million operations.
- ★ High-switching capacity—passes B.S. frequent-duty switching capacity test of 90 amperes at 400 volts, 50-cycles at .45 power actor 50 times at 3-second intervals.
- ★ Overcurrent releases of accurate solder-film pattern have the following features:—
  - **Hand reset.**
  - **Vibration-proof.**
  - **Easily fitted overload heaters for any h.p. — facilitates stocking.**
  - **Unauthorised change of overload setting impossible.**



Closed View showing pushbuttons in lid.

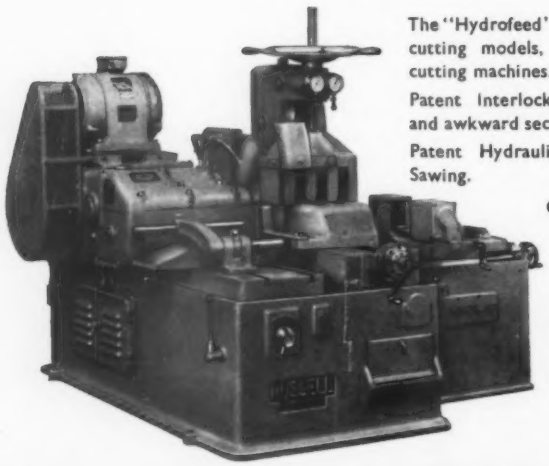
Visit our Exhibit
STAND C.417
B.I.F.
Birmingham
Apl. 27th.—May 8th.

DONOVANS

THE DONOVAN ELECTRICAL COMPANY LTD.
Safuse Works · Stechford · Birmingham, 9

RUSSELL

METAL SAWING MACHINES



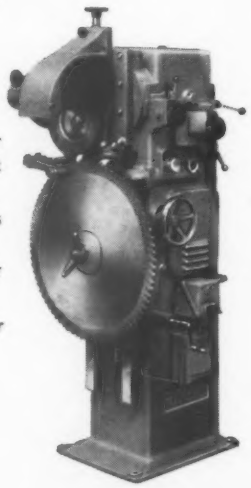
The "Hydrofeed" range includes Straight and Angular cutting models, "Automatics," and special Billet cutting machines.

Patent Interlocking Vices can grip several bars and awkward sections.

Patent Hydraulic Circuit specially designed for Sawing.

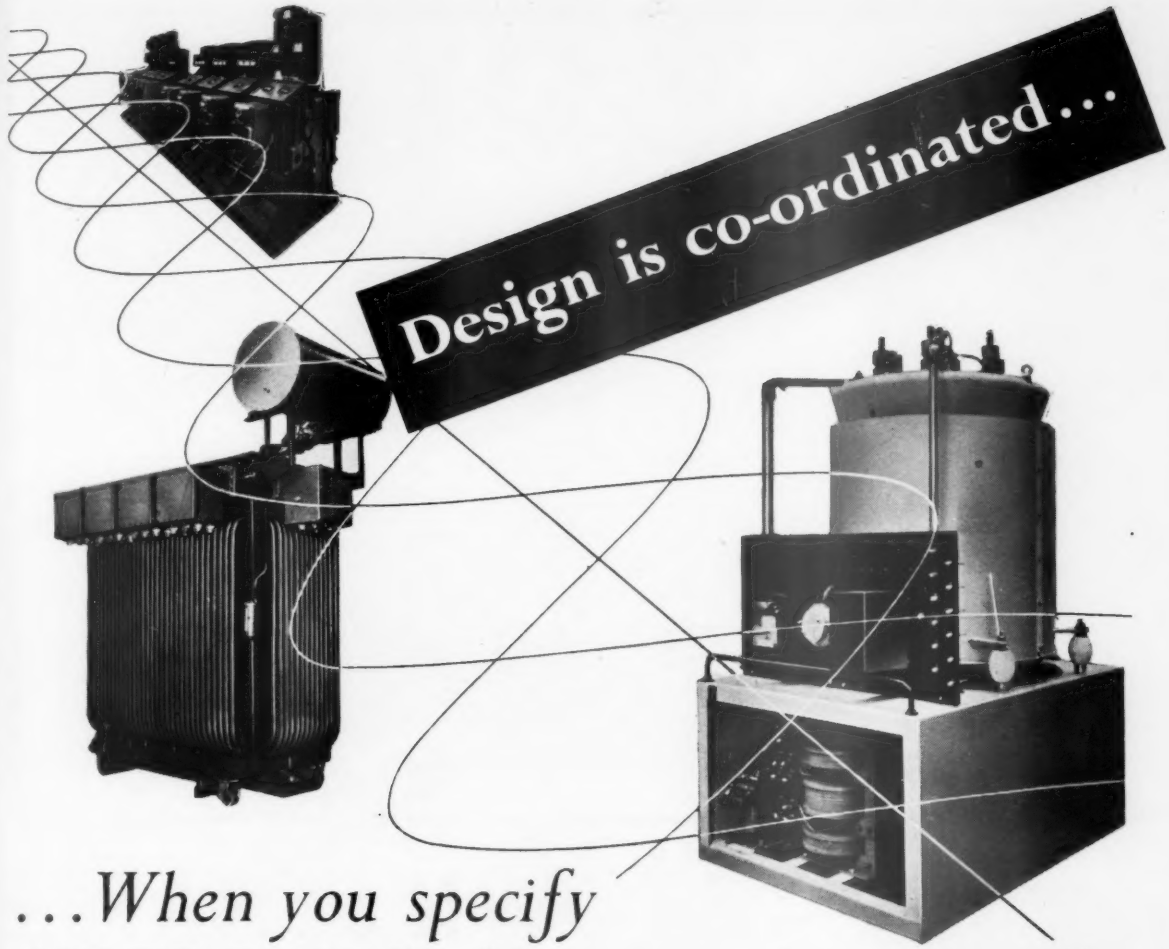
Capacities up to 13½" diameter or 24" × 10" R.S.J.

'HYDROFEED' COLD SAWING MACHINE
Automatic bar feed.



SAW SHARPENING MACHINE
Capacity 11" to 48" blades

S. RUSSELL & SONS LIMITED • LEICESTER • ENGLAND



...When you specify METROVICK Mercury-Arc Rectifiers

Metropolitan-Vickers produce a wide range of glass bulb, pumpless steel tank and continuously evacuated steel tank mercury-arc rectifiers. Further, the company's service covers a complete installation including rectifiers, transformers, switchgear and all auxiliary equipment. In this way design is co-ordinated throughout and full advantage taken of the breadth of Metrovick experience over the whole field of power supply. Any service requiring D.C. power, from general industrial applications to tram, trolleybus and heavy traction requirements, can be met from the Metrovick series of rectifiers. Write for full technical details.

Metrovick 3,000 amp pumpless steel tank rectifier equipment showing one rectifier withdrawn on its carriage.

METROPOLITAN-VICKERS ELECTRICAL COMPANY LIMITED, TRAFFORD PARK, MANCHESTER 17

Member of the A.E.I. group of companies.

METROVICK Rectifiers for D.C. Power Supplies

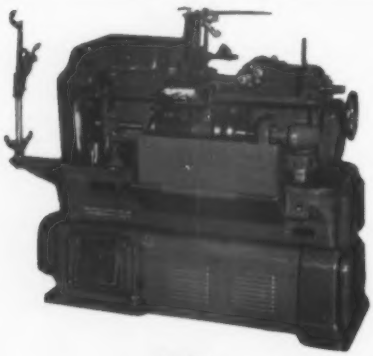
C/R 203

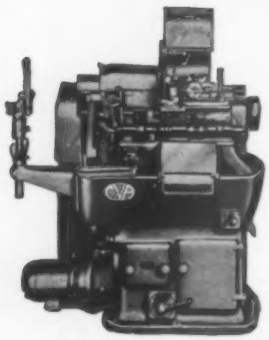
Unique

"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method.

C. P. Newall & Co., Ltd.

POSSILPARK GLASGOW · N



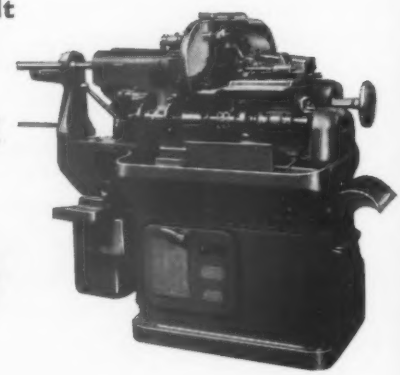


BROWN & SHARPE

AUTOMATIC

RECONDITIONING SPECIALISTS

Your own machines re-built to original specification



THIS SPECIALISED SERVICE IS ALSO OFFERED ON

CVA B.S.A.

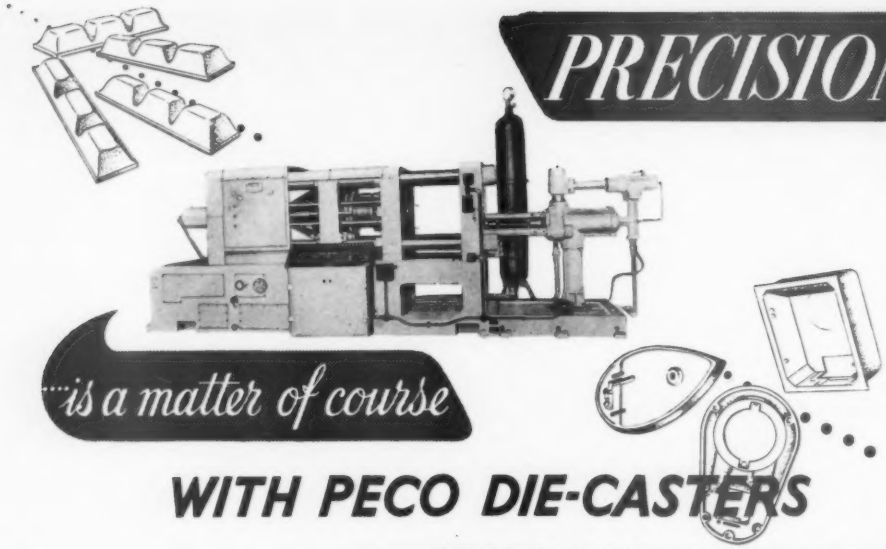
May we visit your works and quote for re-conditioning your machine

Managing Director, H. E. Slawson, M.B.E., M.I.Prod.E

MELBOURNE ENGINEERING CO. LTD.

MELBOURNE, NEAR DERBY. TELEPHONE : MELBOURNE 232

into the air Faster
Galtona
TRADE MARK
O-K
SERRATED BLADE CUTTERS
Speed production on Britain's aircraft
At Gloster Aircraft Ltd., high performance aircraft are coming off the production lines at an ever-increasing rate, and on milling operations "Galtona-O.K." serrated blade cutters have proved their ability to sustain high speed output over long periods without breakdown. A typical set-up is the milling of aluminium alloy windscreen arches as shown. A "Galtona-O.K." combination half side cutter is used, fitted with cemented carbide tipped blades. Speed is 200 r.p.m., with a feed of 6 in. per minute and depth of cut 1¼ in.
There are "Galtona-O.K." serrated blade cutters to speed production on your own work. Ask for details.
Richard Lloyd Limited
STEELHOUSE WORKS · OLIVER STREET · BIRMINGHAM 7
Telephone Aston Cross 3001 (12 lines) Telegrams "Cogs, Birmingham"
NORTHERN AREA OFFICE: A. V. Green, Britannia House, Wellington Street, LEEDS
LONDON AREA OFFICE: A. J. Percy, 240, Romford Road, Forest Gate, LONDON, E.7. • SCOTLAND: Stuart & Houston, 5, York Street, GLASGOW, C.2
PRO 102



PRECISION....

....is a matter of course

WITH PECO DIE-CASTERS

ELECTRICAL SEQUENCE CONTROL

The new PECO Cold Chamber Die-Caster has modernised the technique of cold-chamber die-casting, producing castings that are clean and accurate in dimension, reducing the need for further machining to a minimum.

Largely contributing to this result is the Electrical Control—a unique PECO feature—which covers every movement of the cycle and ensures continuity and uniformity of production.

The PECO Die-Caster has four core-pulling connections, two for each platen, a built-in central hydraulic ejection cylinder and four bumper bars for mechanical ejection. All these mechanisms are fully interlocked and controlled, permitting operation in any sequence.

The central hydraulic ejector may also be used as a core-puller. This virtually increases the effective die-opening by as much as six inches, for, by withdrawing the core before parting the dies, more space is available for casting removal.

These features and many others are fully described in our brochure which we shall be pleased to forward to you on request.

THE PROJECTILE & ENGINEERING COMPANY LTD.

PECO PRODUCTS

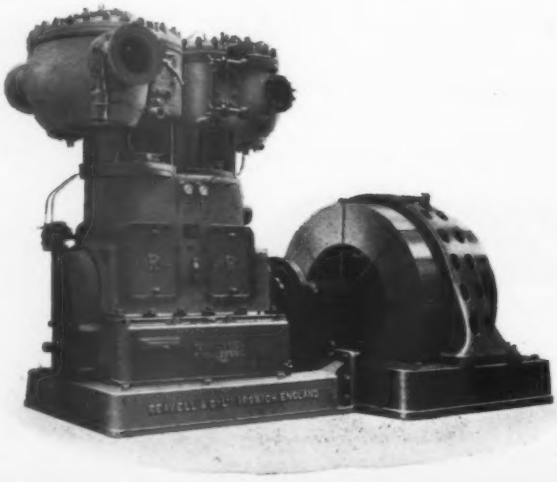
ACRE STREET, BATTERSEA, LONDON, S.W.8. *Cables:* PROFECTUS, LONDON, *Telephone:* MACAULAY 1212, *Telegrams:* PROFECTUS, CLAPHOAD, LONDON

WHEN YOU ARE WANTING NEW

AIR COMPRESSORS

DO NOT FORGET THAT WE HAVE

A COMPLETE RANGE TO SUIT ALL DUTIES



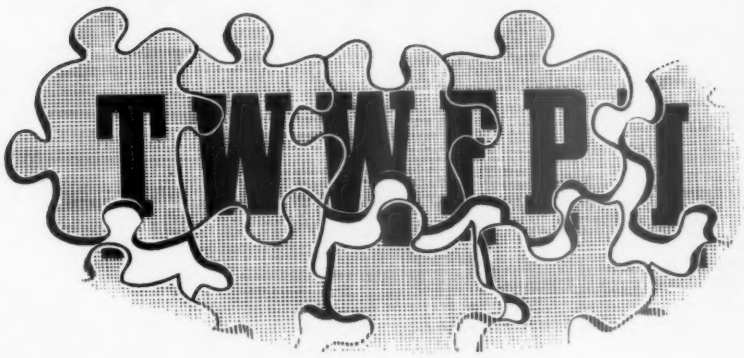
Whatever it is you need—large or small capacity—high or low pressure—we can supply the best machine for the purpose, and our fifty years of specialised experience are at your service.

REAVELL & CO. LTD.

IPSWICH

Telegrams: Reavell, Ipswich Telephone Nos.: 2124-5

?



To complete the picture

The perfect co-ordination of a number of separate services produces the entity which is TWWFPI. Transportation dovetails with planning, planning fits in with production, production demands grouping and, overall, the inescapable factor of opportunity hanging on the coat tails of time.

These are just some of the factors involved in the planned workshop re-organisation which industry knows as TWWFPI. Briefly, the service brings to factory planning and plant installation the unrivalled resources of the Thos. W Ward Group plus the experience and specialized equipment of the Company's F.P.I. Department.

No job is too small nor any job too big for TWWFPI. From the simple re-siting of one or two machines to the complete re-organization of big workshops there is a quiet efficiency about TWWFPI which commends itself to engineers in many industries. Whenever factory re-organization is a problem TWWFPI can tackle the whole job efficiently.

Write for the booklet "FACTORY PLANNING & INSTALLATION"

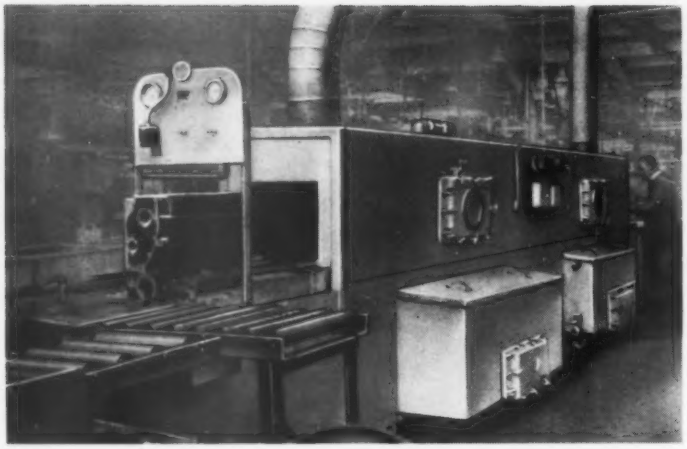
THOS. W. WARD LTD

FPI DEPARTMENT

ALBION WORKS · SHEFFIELD

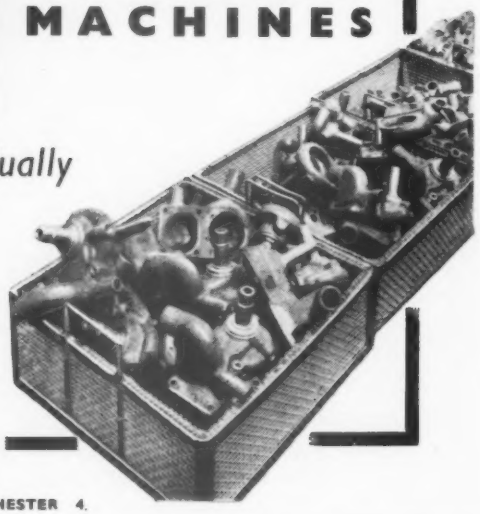
PHONE : 26311 (22 lines) *GRAMS :* "FORWARD, SHEFFIELD"

LONDON OFFICE : BRETTENHAM HOUSE, LANCASTER PLACE, STRAND, W C.2



Bratby

INDUSTRIAL CLEANING MACHINES



Each cleaning problem studied individually

THIS ILLUSTRATION SHOWS A MACHINE CLEANING CRANK CASES IN THE PRODUCTION LINE. IT IS EQUALLY CAPABLE OF CLEANING SMALL PARTS IN BASKETS.

Bratby & Hinchliffe Ltd.

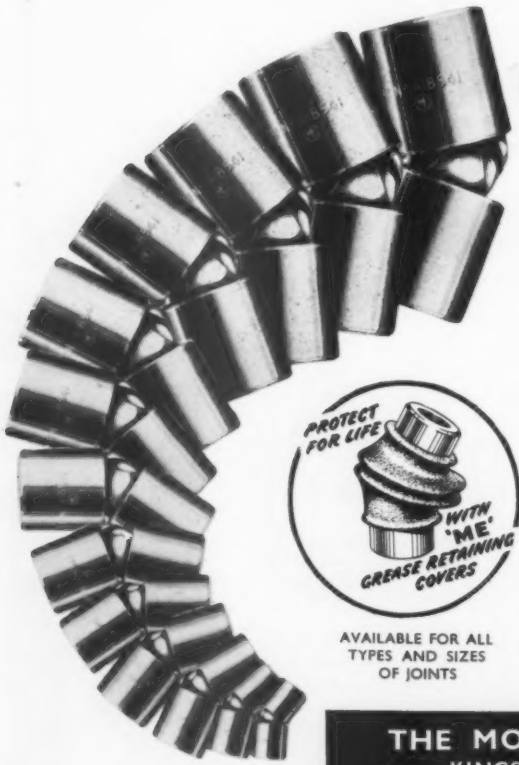
SOLE AGENTS FOR GREAT BRITAIN:

GEO. H. HALES MACHINE TOOL CO. LTD.

VICTOR HOUSE · 1, BAKER STREET . LONDON, W.1.

Designed and manufactured by

BRATBY & HINCHLIFFE LTD., SANDFORD STREET, ANCOATS, MANCHESTER 4.



ON LAND - IN THE AIR - ON THE SEA

ME

UNIVERSAL JOINTS

Are unsurpassed for Efficiency, Power and Endurance

ME Joints are manufactured under ideal conditions, by specially designed single purpose plant. Rigid inspection of components is made after each operation, and heat treatments are scientifically controlled.

AVAILABLE FOR ALL TYPES AND SIZES OF JOINTS

'HOOKES' TYPE UNIVERSAL JOINT

For less severe duty than the 'Patent' joint. Withstands some tension or compression loads.

'ME' PATENT UNIVERSAL BALL JOINT

Combines high load carrying capacity, simplicity of design and utmost reliability. 92%–98% efficient (N.P.L. certified).

'HOOKES' TYPE LIGHT SERIES UNIVERSAL JOINT

Designed for light duty. Moderate tension and compression loads are allowable.

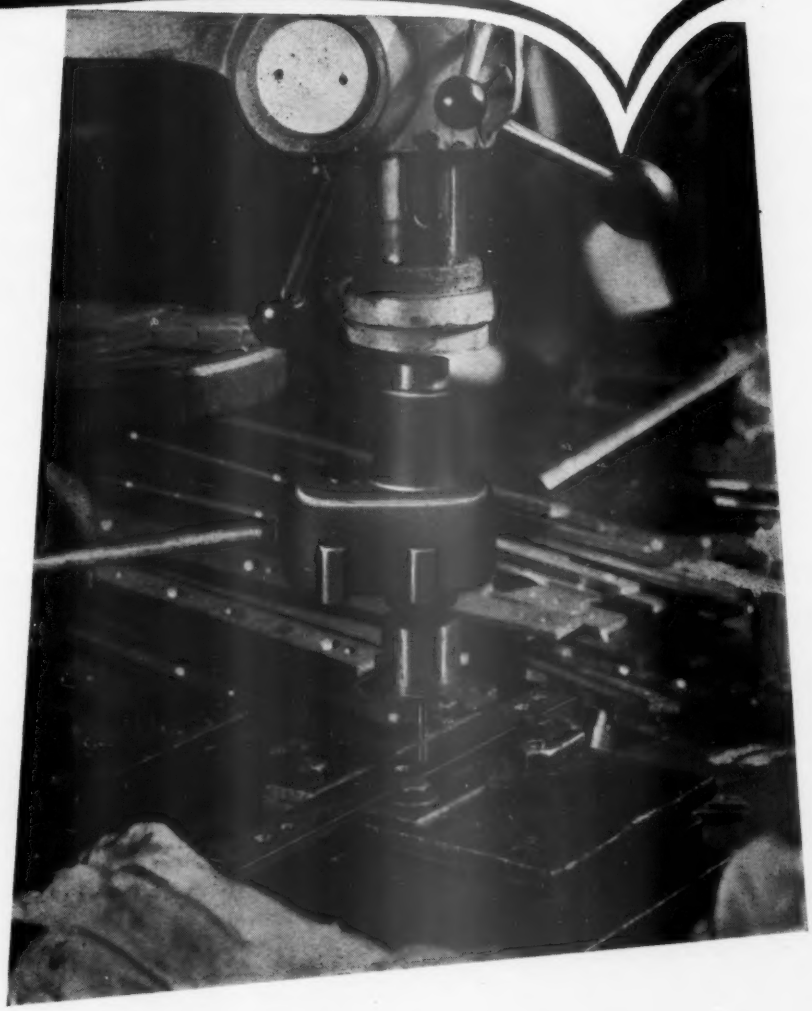
THE MOLLART ENGINEERING COMPANY LTD.

KINGSTON BY-PASS, SURBITON, SURREY, ENGLAND

Tel.: ELMBRIDGE 3352/3/4 'Grams.: PRECISION, SURBITON

Air Ministry Gauge Test House Authority 89755/31

Tapped 100,000 holes and still going strong



The 1/4" B.S.F. Spiral Pointed Tap in the photograph was one supplied by us to the Elmdon Works of Metropolitan Cammell Carriage and Wagon Co., Ltd., last year. With only three regrinds it has already tapped over 100,000 holes in Mild Steel thus having been instrumental in increasing production on that operation by approximately 200%.

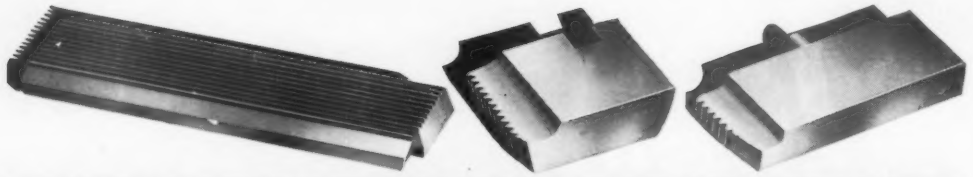
These Taps normally operate at 50/70% of Drilling Speeds.

ESC

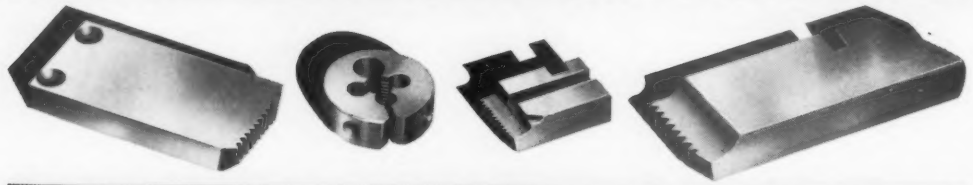
The uniform high quality of every ESC tap ensures dependable performance, long life and complete satisfaction.

Makers of high quality Engineers' Cutting Tools for over a century

ENGLISH STEEL CORPORATION LTD
OPENSHAW MANCHESTER



WINN DIES AND CHASERS for



SCREWING MACHINES, DIEHEADS AND STOCKS

Standard threads from stock in Tangential, Coventry and Geometric types. Quick delivery for all others. Material, workmanship and accuracy guaranteed. WINN Recutting and regrinding a speciality. Consult us on any screwing problems.

CHARLES WINN & CO. LTD
GRANVILLE STREET, BIRMINGHAM, 1
Makers of dies for more than seventy years

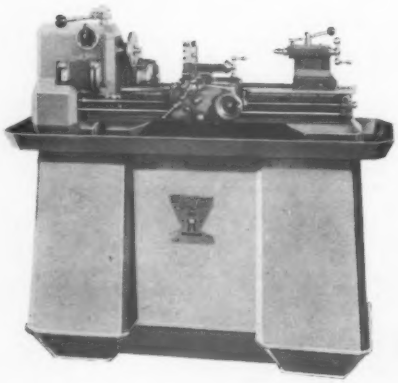
SM/CW. 402

Little John

5″ centre lathe

STEPLESS SPINDLE SPEED VARIATION HARDENED AND GROUND BED SURFACES LARGE HOLLOW SPINDLE TIMKEN ROLLER BEARING SPINDLE

A 5″ Centre Lathe that will comply with the exacting requirements of every discerning Engineer : a Lathe that, having more features than any other of similar size will maintain its technical qualities over many years of use.



RAGLAN ENGINEERING Co (NOTTINGHAM) LTD.

★ *Full specification on request*

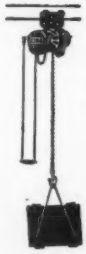
RALEIGH STREET
NOTTINGHAM
Tel. 77215

THE BUTCHER, THE BAKER THE MOTOR-CAR MAKER

USE **KING** MECHANICAL HANDLING EQUIPMENT

Sides of beef, buckets of dough, motor bodies and engines are a few of the things that flow easily on KING electric pulley blocks and runways. In one-man workshops and 50-acre factories, KING lifting and shifting gear keeps things flowing smoothly, effortlessly, economically.

A SINGLE BLOCK OR COMPLETE HANDLING SYSTEM



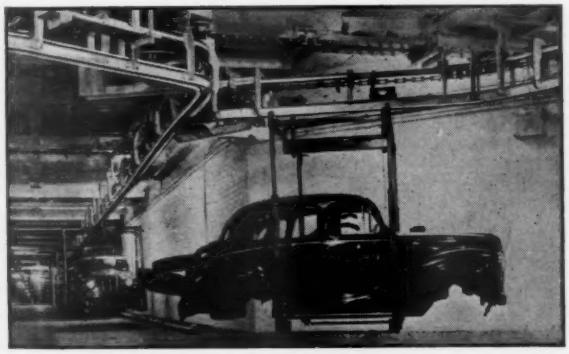
Whether you need a single electric pulley block or a completely mechanised production flow, it will pay you to consult KING. Wherever it is possible to help one man do the job of two with modern mechanical handling gear or wherever idle overhead space can be put to work, KING can show you how.

You will find in KING booklets many useful ideas about Overhead Conveyors, Floor Conveyors, Travelling Cranes, Electric Pulley Blocks and Runways. Look into this. There is no obligation except ours — to speed your output and lower your costs. Call in KING and get things moving!

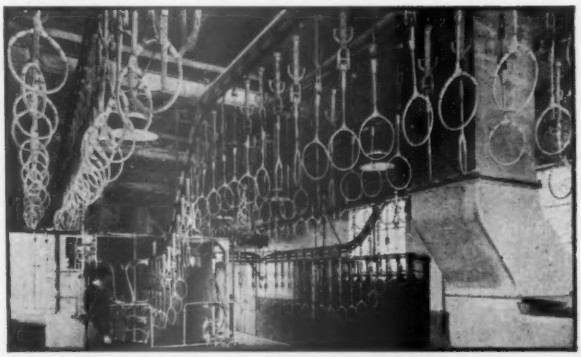
KING

REGISTERED TRADE MARK

PULLEY BLOCKS
CRANES
CONVEYORS

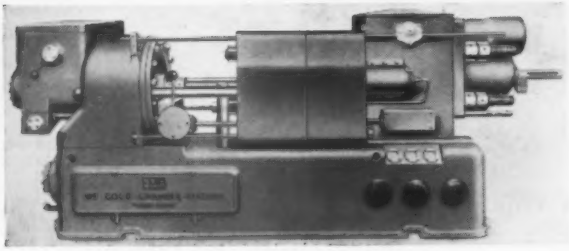


An Austin body goes on a KING Dual-Duty Conveyor to meet its chassis; part of the famous installation at Longbridge — 16 miles of conveyor in all.



Tennis racquets on a KING Power-Pulled Junior Conveyor at Dunlop's Waltham factory. A very different problem from motor bodies — but the results are pleasantly alike — smooth production, lower costs.

WRITE FOR ILLUSTRATED BOOKLETS GEO. W. KING LTD., 502 WORKS, HITCHIN, HERTS. TELEPHONE: HITCHIN 960. AND AT STEVENAGE.



E.M.B. No. 9 Cold Chamber Machine for aluminium die casting.

It's quicker by air

1953 BIP

27 APRIL – 8 MAY
CASTLE BROMWICH
BIRMINGHAM

SEE OUR EXHIBIT

STAND D505
Castle Bromwich

640 HP!!

Work it out for yourself— 21 tons at 450 ft. per min:

The report of W. Babington and D. H. Kleppinger presented to the American Society for Testing Materials confirms that a high plunger speed is the most important factor in die casting. No hydraulic machine can approach the speed of injection developed by E.M.B. engineers—and it is done *without* the use of gas bottles with their inherent drop in pressure at the end of the stroke.

E.M.B. Co. Ltd.

WEST BROMWICH——————————ENGLAND

Dawson

METAL PARTS CLEANING AND DEGREASING MACHINES

ensure the steady flow of production for the export and home markets. Doing the work of many hands in a fraction of the time, they are an important part of the equipment of all modern engineering works. The illustration above shows engine sumps being washed ready for final assembly. Dawson Washing and Degreasing Machines are built to handle all sizes and shapes of metal components.

Used in all branches of Engineering

Sole Distributor

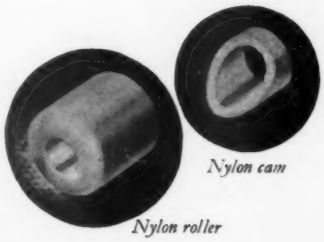
DRUMMOND-ASQUITH (SALES) LTD

King Edward House, New Street, BIRMINGHAM. Telephone: Midland 3431

Manufacturers: DAWSON BROS. LTD., Gomersal, Leeds. Telephone: Cleckheaton 1080 (5 lines)
London Works: 406, Roding Lane South, Woodford Green, Essex. Telephone: Wanstead 7777 (4 lines)

An Expanding Service to Industry...

We at Fraser and Glass have grown up with industrial plastic problems for the last 30 years—and solved them so successfully that we now have one of the largest and best equipped moulding shops in Europe. Did you know, for instance, that we can now undertake *injection* mouldings up to 80 ozs.? And did you know how *many* plastic materials and processes we offer today? Here are some of them . . .



Nylon cam

Nylon roller

FRASER *and* **GLASS**

the plastics people

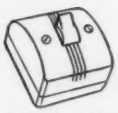
Materials

THERMOSETTING

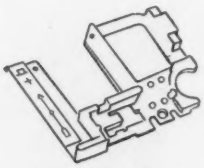
Phenol Formaldehyde, Urea Formaldehyde

THERMOPLASTIC

Cellulose Acetate, Cellulose Acetate Butyrate, Polymethylmethacrylate, Polystyrene including heat resisting and high impact grades, Nylon. Flexible plastics: Polyethylene, Polyvinylchloride



Phenolic switch



Hearing aid chassis in cellulose acetate

Processes

COMPRESSION MOULDING 6 to 500 ton presses

TRANSFER MOULDING

THERMOPLASTIC INJECTION MOULDING

Mouldings from 1/80th oz. to 80 ozs.

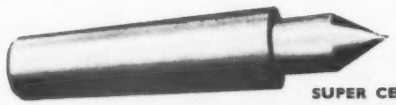
THERMOPLASTIC BLOW MOULDING

Polyethylene bottles and other containers

Polyethylene bottle

FRASER & GLASS LTD., WOODSIDE LANE, LONDON, N.12 (HILLSIDE 2224-5)

BE RIGHT IN THE CENTRE



SUPER CENTRE

A permanent Hardened and Ground Socket with RENEWABLE HIGH SPEED STEEL INSERT. Standard inter-changeable inserts enable centre to be quickly replaced.

STANDARD SOLID CENTRES

Precision ground to give perfect concentricity. Tapers to standard gauges. Made in High Grade CARBON ALLOY STEEL, or HIGH SPEED STEEL BUTT WELDED.

The **ARCHER** REVOLVING CENTRES

Revolve with the work and can thus stand up to the higher speeds and heavier work demanded by modern engineering practice.

'ARCHER'

BALL & ROLLER BEARING TYPES

REVOLVING CENTRES

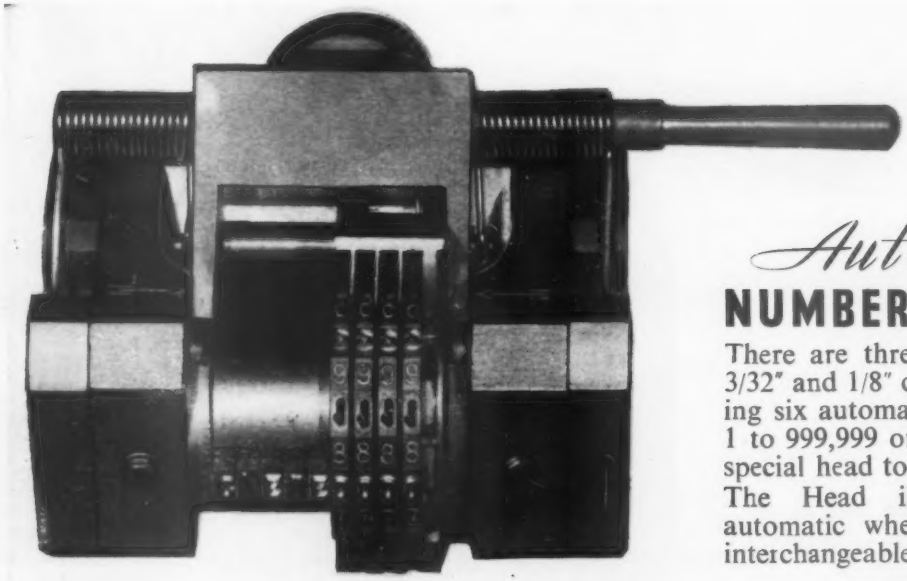
All types of centres are made from the best grade steel, and are designed to give greater efficiency. Take higher speeds, and remain true under the most strenuous conditions of present day engineering.

✻ *ASK FOR LISTS NOS. 50B and 85*

ARCHER SMALL-TOOLS

FRANK GUYLEE & SON LTD

ARCHER TOOL WORKS · MILLHOUSES · SHEFFIELD · 8



HEAVY DUTY

Automatic

NUMBERING HEADS

There are three stock sizes—1/16", 3/32" and 1/8" characters—each having six automatic wheels to number 1 to 999,999 or we will make you a special head to suit your own needs. The Head illustrated has four automatic wheels prefixed by five interchangeable characters.

Write for free descriptive leaflet.

EDWARD PRYOR & SON LTD BROOM ST SHEFFIELD

The illustration above shows castings which have been pressure die cast in aluminium and "Mazak" zinc alloys

WOLVERHAMPTON DIE-CASTING CO. LTD.

GRAISELEY HILL • WOLVERHAMPTON

TELEPHONE: 23831/4 WOLVERHAMPTON. TELEGRAMS: DIECASTINGS, WOLVERHAMPTON

American Affiliation: PRECISION CASTINGS CO. INC. · FAYETTEVILLE · SYRACUSE · CLEVELAND · KALAMAZOO · CHICAGO

"I THINK IT'S HIGH TIME, POLLOCK, THAT MORE PEOPLE IN INDUSTRY REALISED THAT STAINLESS STEEL TUBES HAVE MORE THAN CLEANLINESS TO RECOMMEND THEM—THEY ARE ECONOMICAL TOO"

I quite agree, Accles

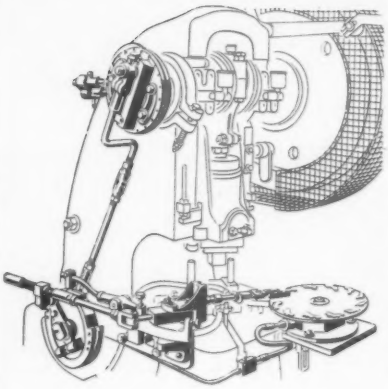
FIRST COST IS THE LAST COST WITH STAINLESS STEEL TUBES

***Accles & Pollock** will gladly send you a copy of their publication, "Corrosion and Heat-resisting tubes".*

Accles & Pollock Ltd · Oldbury · Birmingham · A Tn Company

Makers and manipulators of seamless tubes, in stainless and other steels

TAW/83



from 750 per hour to 3000 Components per hour

The Mechanical Hand is the perfect answer to maximum production with absolute safety, production rates on second operation work increasing to three or four fold. All hazards usually associated with power press work are eliminated as the operator's hands do not enter the tool area.

Technical representatives are available in all parts of the country. Illustrated brochure available on request.

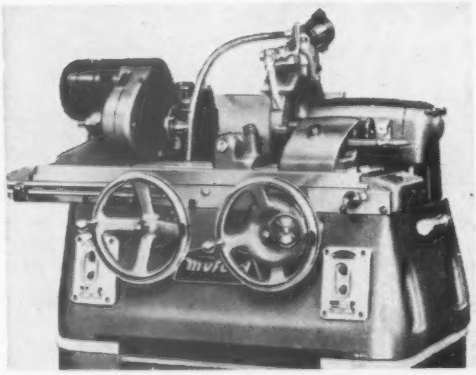
PRESS EQUIPMENT CO.

76-78 Hunters Vale, BIRMINGHAM, 19

Telephone : Northern 4823

★ MYFORD ★

PRECISION CYLINDRICAL GRINDING MACHINE



Designed to produce work to the finest grinding limits with a minimum outlay of initial costs, the MG9 Precision Cylindrical Grinder has in the post-war years proved itself to be a machine tool of high quality, great accuracy and complete reliability.

Work Swing 5" diameter. Between Centres 9"
Dial Reading .0001" Fine Feed .00005"

NOW AVAILABLE WITH INTERNAL GRINDING ATTACHMENT

Send for Publication 900

MYFORD ENGINEERING COMPANY LIMITED

BEESTON · NOTTINGHAM · Phone: 54222 (3 lines)

ELECTRIC OVERHEAD TRAVELLING CRANES

Even today there are factories in which both time and money are wasted in the handling of goods. Paterson Hughes Overhead Electric Cranes solve the handling problem, where a large area has to be served. Paterson Hughes are the acknowledged experts in the design and construction of bulk handling plant of all types.

DESIGN ★

SERVICING ★

MANUFACTURE ★

INSTALLATION ★

5-ton Overhead Travelling Cranes at work in a timber yard.

PATERSON HUGHES ENGINEERING COMPANY LIMITED

LONDON: **BEDFORD HOUSE BEDFORD STREET STRAND LONDON WC2**
Tel: TEMPLE BAR 7274/6

BIRMINGHAM: **3 HIGHFIELD ROAD EDGBASTON BIRMINGHAM 16**
Tel: EDGBASTON 1639

GLASGOW: **WYNDFORD WORKS MARYHILL GLASGOW**
Tel: MARYHILL 2172/4

P2493

JIG & TOOL DESIGNS OF QUALITY

Manufactured with Accuracy

We are specialists in the design of Jigs, Fixtures, Tools, Gauges, and Special Purpose Machines of every description.

DESIGNEX (COVENTRY) Ltd

BROOMFIELD RD., EARLSDON, COVENTRY, ENGLAND.

Telephone: Coventry 64049 (2 lines)

"Gad, sir—give me the old-fashioned methods of raising steam—they're much dirtier!"

"Steam without dirt, smoke and grime! Steam without a special boiler room! Steam 'on tap' just when you want it! Are you dreaming sir? It's not possible". But it is, you know. Just send for details of AUTOLEC steam raising by Electricity. It's a revelation—and a revolution.

AUTOLEC

Steam Raisers

G.W.B. ELECTRIC FURNACES LIMITED
DIBDALE WORKS, DUDLEY, WORCS.

Telephone: Dudley 4284. Telegrams: Gibwildbar, Dudley.
Proprietors: Gibbons Bros. Ltd., and Wild-Barfield Electric Furnaces Ltd.

QUALITY WORKMANSHIP

SPURS
SPIRALS
BEVELS
WORMS
&
WHEELS

We supply these requirements complete or from customers' blanks, and offer quick service and prompt delivery.

RELIANCE GEAR & ENGINEERING CO. (SALFORD) LTD.
DICKINSON STREET · SPRINGFIELD LANE
SALFORD 3
Phone: BLAckfriars 0164 & 1715
Grams: MOTOGEARS

MACHINERY'S
TECHNICAL BOOKS

MACHINERY'S HANDBOOK. Nearly 2,000 pages packed with the most up-to-date and complete collection of data, standards formulæ and practical information. Amply illustrated by diagrams throughout, it presents all the essential requirements covering the entire field of shop practice and machine tool design. Price **66/6**. Cash and C.O.D. Instalments 73/- payable 13/- in 10 days, 12/- monthly. Overseas, cash with order plus 1/7d. postage.

A NEW APPROACH TO ENGINEERING TOLERANCES. The main purpose of this book is to dispel some of the prevalent misunderstandings in the subject of tolerances, by presenting a more comprehensive and realistic view of the practical factors involved than is usually envisaged by those concerned. The subject matter, being presented from the producer's viewpoint, covers: General tolerances for various production methods, effect of tolerances on fits, effect of tolerance accumulation on assemblies, method of expressing tolerances on drawings, standard limit and fit systems, implementation of recommendations, etc. Price **10/6** Cash and C.O.D. Instalments, **11/6** payable 5/9 in 10 days, 5/9 one month later. Overseas, cash with order plus 10d. postage.

GANTT CHART. These charts are perhaps the most notable contribution to the art of management made in this generation. Their special features are simplicity, compactness, the facility with which they can either be prepared or read and their adaptability to large or small firms irrespective of trade. Price **7/6** Cash and C.O.D. Instalments **8/3**. Overseas, cash with order plus 11d. postage.

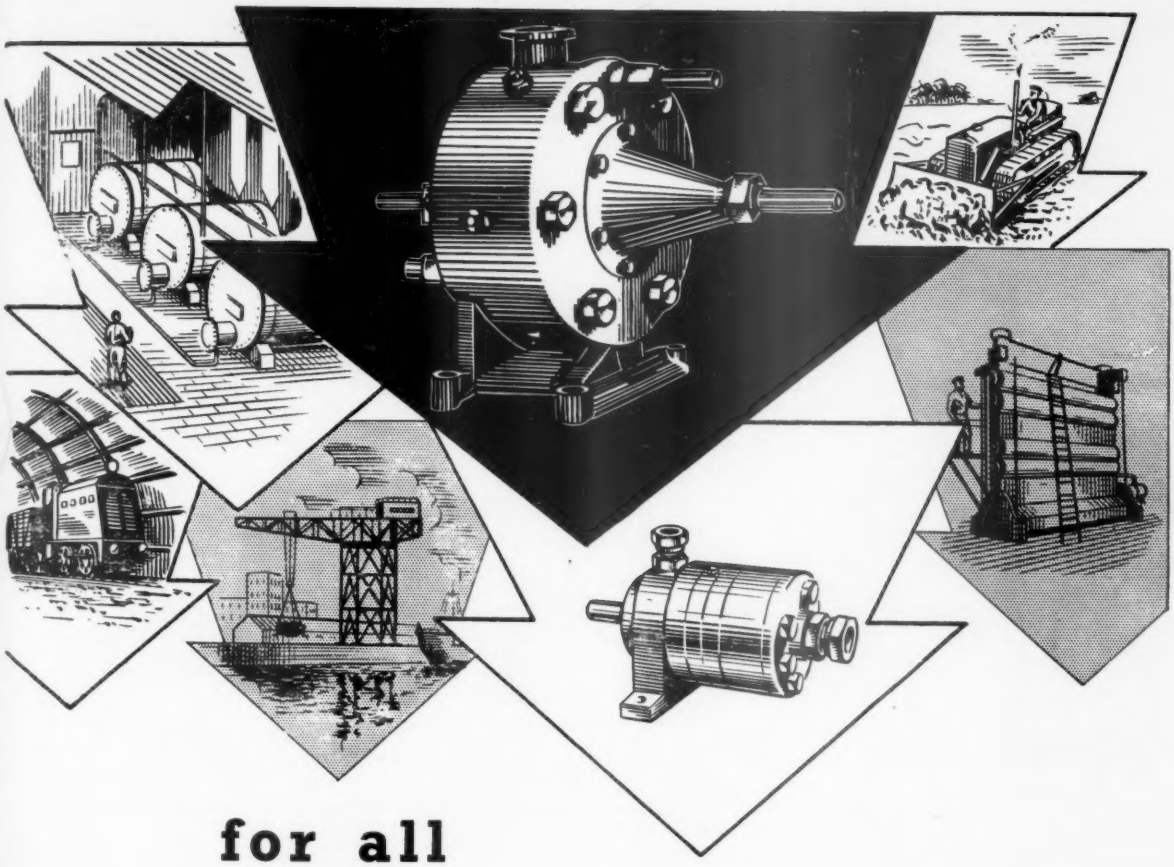
To MACHINERY, National House, West Street, Brighton, 1, Sussex, Eng.
Please send me book/s marked "X".

For CASH herewith or by C.O.D., or
ON APPROVAL when I will either return in 5 days or pay FULL CASH, or pay by INSTALMENTS as stated above.

Name..... Position.....

Address..... Firm.....

Book Catalogue sent on request. I.P.E. 5/53



for all applications of hydraulic power . . .

FRASER

Mono Radial

AND DERI-SINE PUMPS

The range of Fraser Mono-Radial and Deri-Sine Hydraulic Pumps covers the complete range of industrial applications where smooth, controlled power is required.

THE MONO-RADIAL PUMP

The Mono-Radial pump combines high and low pressure outputs in one pump, giving high speeds of operation with economy of power standard pressure range up to 6,000 p.s.i.

THE DERI-SINE PUMP

The Deri-Sine pump gives true STRAIGHT LINE FLOW free from pulsations of any periodicity. For pressures up to 2,000 p.s.i. and ranging from fractional outputs up to 90 g.p.m.

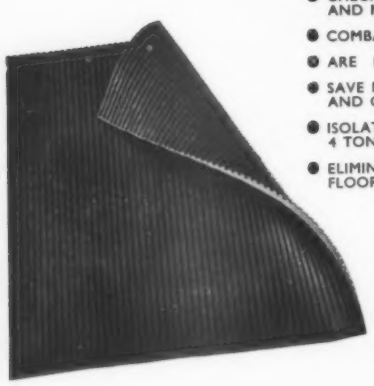
ANDREW FRASER & CO. LTD., 29 BUCKINGHAM GATE, LONDON, S.W.1. Tel: VICTORIA 6736-9

Rooster 2724

VULCASCOT ANTI-VIBRATION PADS

OIL RESISTING

Improve VULCASCOT REG. TRADE MARK *Production!*



- CHECK VIBRATION SHOCK AND NOISE
- COMBAT NERVOUS STRAIN
- ARE EASY TO INSTALL
- SAVE MAINTENANCE TIME AND COST
- ISOLATE LOADS UP TO 4 TONS PER SQ. FT.
- ELIMINATE CUMBERSOME FLOOR FIXINGS

Standard Size
18" x 18" x ½"

Manufactured by:

VULCASCOT (Great Britain) LTD.

87-89, ABBEY ROAD, LONDON, N.W.8.

PHONE: MAIDA VALE 7374 & 7375. 'GRAMS: VULCASCOT MAIDA VALE LONDON.

HUNDREDS of craftsmen use the DIPROFIL★ HAND FILING MACHINE

For FILING, SCRAPING, LAPPING, MILLING, GRINDING and general finishing

The DIPROFIL, power operated, multi-purpose machine increases production, conserves energy & saves time & money.

★ Featuring Diamond and Carbide Cutting Tools

DEROTA WORKSHOP UNIT (also power unit to the DIPROFIL)

BROOKS & WALKER LTD.

47, GREAT EASTERN ST., LONDON E.C.2. Bishopsgate 7633

TT RIVET SPINNING MACHINES....

for effortless silent rivetting!

Whether it's a small aluminium rivet in a fragile component or a large steel stud in a gear box, a TT Rivet Spinner will give it a perfectly finished head and improve the look of your product. The process is quick and efficient—and it is equally suitable in certain applications for spinning over bushes and flanges.

Models available for Foot or Air Operation, with capacity up to ¾" dia. in steel. We also manufacture a full range of Rotary Vibrating Riveting Hammers.

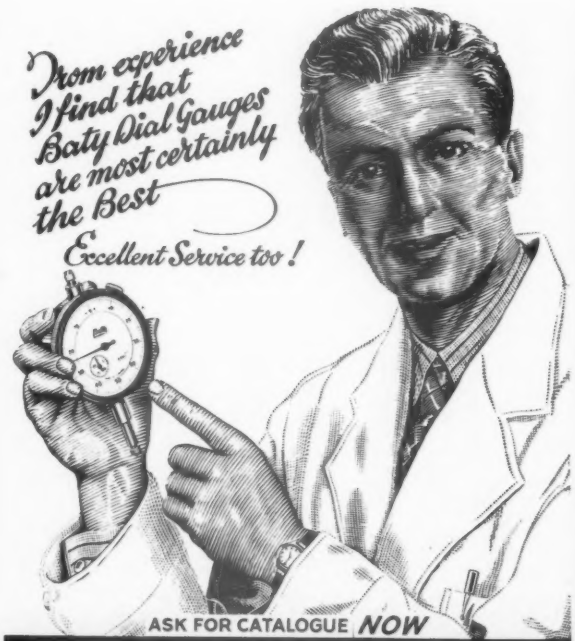
We offer our expert advice and shall be pleased to demonstrate on your samples.

Ask for details from your usual Machine Tool Merchant or from:

RS.8.AE.MD. ¾" Cap. Air-operated Rivet Spinning Machine with Special Fixture

TURNER MACHINE TOOLS LTD.

63-68, PRINCIP STREET · BIRMINGHAM · 4



ASK FOR CATALOGUE *NOW*

J. E. BATY & Co LTD

39 VICTORIA STREET, LONDON, S.W.1

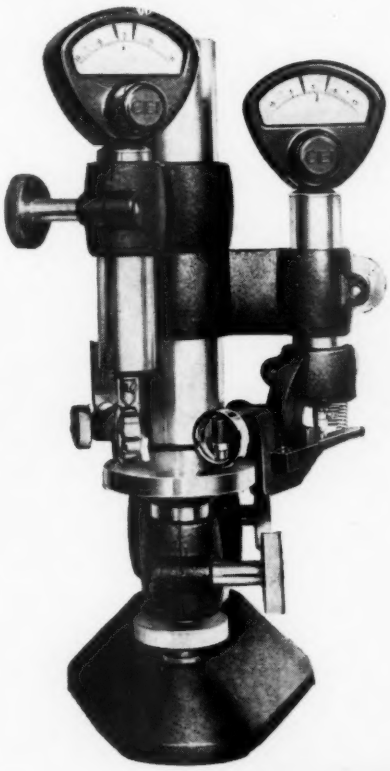
ABBEY 1718

CEJ ... for extra precision and quality

CEJ Mikrokator

The CEJ Mikrokator is an entirely frictionless mechanical comparator. Amplification by a twisted strip to the pointer without friction between solids or fluids. Special construction enables the pointer to come quickly to rest.

Measuring ranges vary from .006" to .0001", the graduations varying from .0001" to .000002".

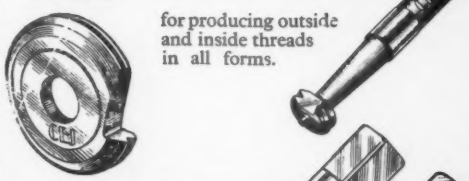


CEJ PLUG & RING GAUGES

are in steadily increasing demand throughout industry. Their precision and exemplary accuracy ensure complete satisfaction.

CEJ CIRCULAR CHASERS

for producing outside and inside threads in all forms.



CEJ TAPS

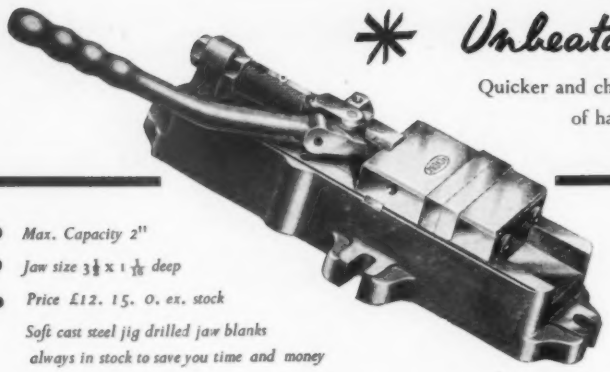
Spiral Flute taps for blind hole tapping. Spiral Point taps for through hole tapping. In each case only one tap is needed.

C.E. JOHANSSON LTD.

PRECISION TOOLS AND INSTRUMENTS

SOUTHFIELDS ROAD, DUNSTABLE, BEDS · TEL: DUNSTABLE 422/3

DHB



✱ *Unbeatable for repetition work . . .*

Quicker and cheaper than air or screw operation—one simple pull or push of handle gives instant rigid grip or $\frac{3}{4}$" opening to facilitate easy an speedy insertion and removal of the component.

- *Max. Capacity 2"*
- *Jaw size $3\frac{1}{2}$ x 1 $\frac{1}{16}$ deep*
- *Price £12. 15. 0. ex. stock*

Soft cast steel jig drilled jaw blanks always in stock to save you time and money

Thrust taken by rigid fixed jaw—Handle adjustable for right or left hand or vertical operation.

"ACVOKE" *QUICK-GRIP* VICE

ACCLES & SHELVOKE LIMITED · BIRMINGHAM · 6

7056

INDEX TO ADVERTISEMENTS

	Page
Accles & Pollock, Ltd.	LXIV
Accles & Shelvoke, Ltd.	LXX
Adam Machine Tool Co., Ltd. ...	XLVI
Allen, Edgar & Co., Ltd. ...	XVI
Andrews, Harold, Grinding Co., Ltd.	XLIX
Asquith, William, Ltd.	XXVI
Automatic Coil Winder & Electrical Equipment Co., Ltd. ...	—
Barber and Colman, Ltd. ...	—
Baty, J. E., & Co., Ltd.	LXVIII
Birlec, Ltd.	XXXIV
Birmingham Aluminium Casting (1903) Co., Ltd.	—
Block and Anderson, Ltd. ...	—
Bratby and Hinchcliffe, Ltd. ...	LVI
Bray, George, & Co., Ltd. ...	—
British Aero Components Ltd. ...	—
British Die Casting and Engineering Co., Ltd.	XXVIII
British Electrical Development Association	XXXII
B.H. Chemicals, Ltd.	—
British Industrial Plastics, Ltd. ...	XIII
British Tabulating Machine Co., Ltd.	XXXVII
British Thomson-Houston Co., Ltd.	—
Brooks and Walker, Ltd. ...	LXVIII
Broom and Wade, Ltd.	XXXVIII
Brown, David, Machine Tools, Ltd.	XXIX
Catmur Machine Tool Corporation, Ltd.	XIV
Churchill, Charles & Co., Ltd. ...	—
Churchill Machine Tool Co., Ltd.	—
Cincinnati Milling Machines, Ltd.	III
Climax Rock Drill & Eng. Works Ltd.	—
Coventry Gauge and Tool Co., Ltd.	—
Dawson Bros., Ltd.	LX
Dean Smith and Grace, Ltd. ...	XLV
Designex (Coventry), Ltd. ...	LXVI
Donovan Electrical Co., Ltd. ...	L
Drummond-Asquith (Sales), Ltd.	XXVII
Drummond Bros., Ltd.	XII
Dyson and Co. Enfield (1919), Ltd.	VI
E.M.B. Co., Ltd.	LX
English Electric Co., Ltd. ...	—
English Steel Corporation, Ltd.	LVII
Firth Brown Tools, Ltd. ...	XV
Firth, Thos., & Brown, John, Ltd.	XXXIX
Fisher and Ludlow, Ltd. ...	—
Flame Hardeners, Ltd.	—
Fox, Samuel & Co., Ltd. ...	XVII
Fraser, Andrew, & Co., Ltd. ...	LXVII
Fraser & Glass, Ltd.	LXI
Gledhill-Brook Time Recorders, Ltd.	XLVIII
G.P.A. Tools and Gauges, Ltd. ...	XXXVI
Guest, Keen & Nettlefolds (Midlands), Ltd.	—
Guylee, Frank, and Son, Ltd. ...	LXII
G.W.B. Electric Furnaces, Ltd. ...	LXVI
Hampton, C. and J., Ltd. ...	—
Harrison, T. S., and Sons, Ltd.	—
Harris Tools, Ltd., John ...	XLVIII
Herbert, Alfred, Ltd.	XXXIII
Hilger and Watts, Ltd.	—
Holbrook Machine Tool Co., Ltd.	—
Holman Bros., Ltd. *Outside Back Cover*	
Hoover, Ltd.	XXXI
Horden, Mason and Edwards, Ltd.	XXI
Imperial Smelting Corporation (Sales), Ltd.	XIX
Impregnated Diamond Products, Ltd.	X
Johansson, C. E., Ltd.	LXIX
Jones, E. H. (Machine Tools), Ltd.	XLIII
Jones, Sidney G., Ltd.	XX
King, Geo. W., Ltd.	LIX
Lancashire Dynamo and Crypto, Ltd.	—
Lancing Machine Tools, Ltd. ...	IX
Lang, John, and Sons, Ltd. ...	—
Lang Pneumatic Ltd.	—
Lapointe Machine Tool Co., Ltd.	—
Lloyd, Richard, Ltd.	LIII
Lund, John, Ltd.	IV
Machine Shop Equipment, Ltd.	VIII
Machinery Publishing Co., Ltd.	LXVI
Mairbaix Gaston E., Ltd.	XXII, XXIII
Marshall-Richards Machine Co., Ltd.	—
McGraw-Hill Publishing Co., Ltd.	XLVII
McKechnie Bros., Ltd.	XLIV
Melbourne Engineering Co., Ltd.	LII
Metropolitan-Vickers Electrical Co., Ltd.	LI
Mollart Engineering Co., Ltd. ...	LVI
Monks and Crane, Ltd. ...	VII
Myford Engineering Co., Ltd. ...	LXIV
Neill, James, and Co. (Sheffield), Ltd.	—
Newall, A. P., and Co., Ltd. ...	LII
Newall Group Sales, Ltd. ...	XXX
Park Gate Iron and Steel Co., Ltd. ... ... *Inside Back Cover*	
Parkinson, J., and Son (Shipley), Ltd.	XXIV
Paterson Hughes Engineering Co., Ltd.	LXV
Power-Samas Accounting Machines (Sales) Ltd.	XXXV
Press Equipment Co.	LXIV
Projectile and Engineering Co., Ltd.	LIV
Pryor, Edward, and Son, Ltd. ...	LXII
Raglan Engineering Co. (Nottingham), Ltd.	LVIII
Ransomes, Sims, and Jefferies, Ltd.	—
Reavell and Co., Ltd.	LIV
Redfern's Rubber Works, Ltd. ...	XLVI
Reliance Gear & Eng. Co. (Salford), Ltd.	LXVI
Riley, Robert, Ltd.	
Russell, S., and Sons, Ltd. ...	L
Scrivener, Arthur, Ltd.	—
Shell Mex and B.P., Ltd. ...	V
Skinners (Redbridge), Ltd. ...	—
Sparklets, Ltd.	—
Spencer & Halstead, Ltd. ...	—
Steel, J. M., and Co., Ltd. ...	—
Sunbeam Anti-Corrosives, Ltd.	—
Swift, Geo., and Son, Ltd. ...	—
Sykes, W. E., Ltd.	XLII
Tecalemit, Ltd.	XL
Teleflex Products, Ltd.	—
T.I. Aluminium, Ltd.	XLI
Turner Machine Tools Ltd. ...	LXVIII
Unbrako Socket Screw Co., Ltd.	XI
United Steel Companies, Ltd. ...	XVII
Van Moppes and Sons (Diamond Tools), Ltd.	—
Vulcascot (Great Britain), Ltd. ...	LXVIII
Ward, H. W., and Co., Ltd. ...	XXV
Ward, Thos. W., Ltd.	LV
Wickman, Ltd.	XVIII
Wild Barfield Electric Furnaces, Ltd.	—
Winn, Chas., and Co., Ltd. ...	LVIII
Wolverhampton Die Casting Co., Ltd.	LXIII
Zinc Alloy Die Casters Association	XLIV

or push
easy an

e adjust-
vertical

VICE

6
7056

Page

Lii
xxx

ck Cover
xxiv
Lxv
es
xxxv
Lxiv
Liv
Lxii

Lviii
—
Liv
xlvi
Lxvi
L
—
v
—
—
—
—
—
xlii
xl
—
xli
Lxviii
xi
xvii
—
Lxviii
xxv
lv
xviii
—
Lviii
Lxiii
xliv

Vol. 32, No. 5

JOURNAL SUPPLEMENT

INSTITUTION OF PRODUCTION ENGINEERS, 36 PORTMAN SQUARE, LONDON, W.1

1953 INSTITUTION CONFERENCE, HARROGATE

All members will now have received particulars of the programme for the Institution Conference to be held in Harrogate in June next, together with application forms for tickets.

Members who propose to attend the Conference are advised to reserve their accommodation at Harrogate without delay, and to notify the Secretary of the Institution as soon as possible.

THE SIR ALFRED HERBERT LECTURE, 1953

As already announced, the Sir Alfred Herbert Lecture, 1953, will be given by Sir John Cockcroft, C.B.E., Ph.D., M.A., M.Sc.(Tech.), D.Sc.(h.c.) Oxford, F.R.S., Hon.LL.D. Toronto, M.IE.E., Director of the Atomic Energy Research Establishment of the Ministry of Supply at Harwell. His subject will be:

"Industrial Applications of Atomic Energy"

The meeting will be held in the Sheldonian Theatre, Oxford, on Friday, 24th July, 1953, commencing at 5.30 p.m. Admission will be *by ticket only*, and members and others intending to be present are asked to make early application, using the form on page 3 of the Supplement.

MEETINGS

This notice is circulated in place of members' lecture tickets which have been discontinued. Visitors' tickets may be obtained from Section Hon. Secretaries.

MAY to JUNE, 1953

SCHOFIELD TRAVEL SCHOLARSHIP LECTURE
LONDON SECTION **7 p.m. MAY 11th**
The Royal Empire Society, Northumberland Avenue, London, W.C.2.

Schofield Travel Scholarship Lecture.

Part I—"Manufacturing Methods of Fractional H.P. Electric Motors as seen in Switzerland."
Part II—"A Glimpse at some German Manufacturing Methods and Administrative Problems," by D. C. Howard, Grad.I.Prod.E. (Winner of the Schofield Travel Scholarship, 1952).

BIRMINGHAM GRADUATE **7 p.m. MAY 12th**
The James Watt Memorial Institute, Great Charles Street, Birmingham.
"Mechanised Inspection" by J. Loxham, M.I.Mech.E., M.I.Prod.E., F.R.S.A.

SHEFFIELD GRADUATE **6.30 p.m. MAY 19th**
The Royal Victoria Station Hotel, Sheffield.
"Application of Tungsten Carbide Tooling" by Mr. Brooke.

SHREWSBURY **7.30 p.m. MAY 27th**
The Shrewsbury Technical College.
"Electronics as an Aid to Productivity" by R. McKennell.

STOKE-ON TRENT SUB-SECTION
7.30 p.m. MAY 15th
The Building Dept., North Staffordshire Technical College, Cauldon Place, Shelton, Stoke-on-Trent.
"Education for Industrial Management" by Professor T. U. Matthew, Ph.D., M.I.Prod.E.

WOLVERHAMPTON GRADUATE **MAY 6th**
Works Visit to Vauxhall Motors Ltd., Luton, Beds.

WOLVERHAMPTON GRADUATE
7.30 p.m. MAY 12th
The Star and Garter Royal Hotel, Victoria Street, Wolverhampton.
Brains Trust on Production Engineering Problems.

WOLVERHAMPTON GRADUATE
7.30 p.m. JUNE 25th
The Star and Garter Royal Hotel, Victoria Street, Wolverhampton.
"British Watch and Clock Production" by R. Lenoir, F.B.H.I.

YORKSHIRE GRADUATE
6.45 p.m. for 7 p.m. MAY 1st
Works Visit to Dawson, Payne and Elliott Ltd., Otley.

YORKSHIRE GRADUATE
6.45 p.m. for 7 p.m. MAY 22nd
Works Visit to Wm. Asquith Ltd., High Road, Halifax.

PRODUCTION APPOINTMENTS

BULLETIN No. 33

This bulletin is circulated to all members of the Institution monthly as near as possible to the first of the month. Firms or organisations wishing to insert notices in the bulletin should communicate with the Secretary at 36, Portman Square, London, W.1.

The last date for receiving material for insertions in the following month's bulletin is the 20th of each month.

The fee per insertion of up to 100 words is now £3 3s., and over 100 words £5 5s. No charge is made to firms affiliated to the Institution, Technical Colleges, Universities and similar organisations.

Advertisers are advised that better response is likely if, in addition to essential qualifications, the following information is given:—

(*a*) Location of appointment; (*b*) Status in the organisation and scope of promotion; (*c*) Salary range and age range.

Advertisers are asked to advise the Institution when vacant appointments are filled. The Institution reserves the right to refuse or withdraw any announcement and also to make any alteration in the wording to ensure conformity with Institution standards.

Members interested in the following appointments should make application in accordance with the terms of notice. No correspondence can be undertaken by the Secretary other than the forwarding of replies to Box Nos.

Works Manager ; Production Manager ; Chief Engineer. One of the largest and oldest established manufacturers of electric home appliances in Canada (including refrigerators, electric cookers, washing machines, etc.), will shortly have the following vacancies in its organisation:

Works Manager. To supervise manufacturing plant employing about 1,000 people, in beautiful city in centre of industrial Ontario, near Toronto. This is a modern plant, equipped with up-to-date sheet metal working equipment, power and brake presses and metal forming machines; continuous porcelain enamelling furnace, bonderising and spray painting plant. Temperature-controlled assembly of components machined to precision limits and fully conveyorised assembly tracks;

Production Manager. To plan, control and achieve results with an expanding schedule and increasing product range;

Chief Engineer. To control and head up an engineering organisation whose functions include a certain amount of product design, engineering specifications for manufacture and purchasing, engineering releases and changes, quality control standards; supervision of engineering laboratories and experimental workshops.

The above vacancies are occasioned by the rapid expansion of the business and the impending retirement of some of our present executives. The appointments will be progressive and well paid, and offer opportunities for men of high calibre. The Company has a fine record of happy relationship with its employees, with generous pension and employee benefit plans. Only men with appropriate educational background and experience, and with a good record of achievement, are invited to apply. The selected applicants will be interviewed in England before the end of the year. Write in confidence, giving age and fullest personal information to Box 588, I.Prod.E., 36, Portman Square, London, W.1.

Demonstrator required for Injection Moulding Machines. Young man with good practical and technical background including knowledge of hydraulics and plastic machines preferred. Good salary and splendid opportunity for advancement. London Headquarters. Write in confidence giving fullest details of experience, to Box 576, I.Prod.E., 36, Portman Square, London, W.1.

Industrial Engineer. A vacancy exists for an Industrial Engineer in a modern factory in the South West Scotland area. Applicants should have some experience in modern industrial engineering, including Time Study and Method Study, but this is not essential as training will be given to the selected candidate. Write stating full particulars and salary expected, to Box 577, I.Prod.E., 36, Portman Square, London, W.1.

Production Engineer, age 25/40, required in the Crushing and Grading section of large works in Manchester. Salary £450 to £550, according to qualifications and experience. Preference will be given to applicant with thorough mechanical engineering training. Experience with quarry plant and machinery or allied trades would be an advantage. Excellent prospects for advancement to man capable of original thought. Box 578, I.Prod.E., 36, Portman Square, London, W.1.

Assistant to Manager. Light engineering firm in South Wales, employing 700, requires Assistant to present Manager and suitable as successor. Must be qualified engineer with extensive practical experience in semi-mass and batch production. Management ability essential. Starting salary not less than £1,200 p.a. Applicants should be aged not less than 35 years. House available. Good Pension Scheme. Applications in writing, stating age, full details of experience and education, to Box 579, I.Prod.E., 36, Portman Square, London, W.1.

Designers—Draughtsmen required, experienced in machine and/or tool design. Men with first-class experience in either of the above branches of design required immediately. Preference given to applicants with practical shop experience who can design for production. State full details, together with age and salary required, to Box 580, I.Prod.E., 36, Portman Square, London, W.1.

Engineers. Progressive posts available for engineers with general or specialised experience in all manufacturing activities encountered in the engineeering industry. Commencing salaries in accordance with age, qualifications and experience. Increments on merit. Those with suitable ability will be advanced to responsible positions in an expanding organisation in the Midland area. Duties include visits to engineering firms throughout the country. Excellent superannuation scheme. Apply giving full details including age, experience, qualifications, salary, etc., to Box 581, I.Prod.E., 36, Portman Square, London, W.1.

Experienced Estimator required. Practical knowledge of press tools an advantage. Progress and responsible position for right applicant. Good rate of pay. 5-day week. Superannuation scheme. Box 582, I.Prod.E., 36, Portman Square, London, W.1.

First-Class Qualified Engineers. Two vacancies exist in a large and progressive Lancashire engineering works for young men aged about 27/30, with a public school education and University degree or their equivalent, who have served a recognised engineering apprenticeship, for training for future executive position in (a) chief-engineer-design department; (b) production control department. Both offer excellent progressive prospects and, after initial training, carry a commensurate salary. There is a generous staff pension scheme. Box 583, I.Prod.E., 36, Portman Square, London, W.1.

Experienced Engineers required for vacancies in works methods department. Applicants should hold H.N.C. (or equal) and have good knowledge of modern machine shop practice or assembly and erection work. Some knowledge of P.W. systems and/or Time Study methods would be an advantage. Superannuation scheme in operation. Apply giving full details of training and experience to Box 585, I.Prod.E., 36, Portman Square, London, W.1.

Engineer with suitable background required to control Standards and Estimating Department and to conduct negotiations with personnel. This position calls for knowledge of personnel relationship allied to full understanding of Time Study and Ratefixing. Good salary. Pension scheme. Modern factory in East Cheshire, on light engineering. State age, background and salary required. Only those applications giving details asked for will be considered. Address to Works Manager, Box 586, I.Prod.E., 36, Portman Square, London, W.1.

Production Executive. Large Midland firm, motor body manufacturers, wish to engage a man at executive level to take full charge of production administration and development of extensive paint plant activities. Successful applicant, who must have first-class qualifications assured good salary and progressive appointment. Box 587, I.Prod.E., 36, Portman Square, London, W.1.

Production Engineer. Experienced men with progressive ideas are invited to apply for the vacancy of Production Engineer to J. and H. McLaren, Ltd., Diesel Engine Manufacturers, Leeds. The appointment requires a man with sound general education and at least Higher National level technically, with wide experience in the fields of Process Planning, Jig and Tool Design, Time Study, and the control of men. Five-day week, non-contributory superannuation. Personal particulars, experience and salary required to Personnel Officer, J. and H. McLaren, Ltd., Airedale Works, Leeds, 10.

Production Engineer required for 1st June, for medium-sized engineering works, Wakefield area, on batch production of riveted, welded and pressed steel platework; responsible for planning and progressing of output, maintenance of delivery schedules, and capable when required of establishing method and routing of production. Must have ample drawing board experience, preferably in jigs and tools. Applicants should possess graduateship of the Institution of Mechanical Engineers or the Institution of Production Engineers, or hold the degree of B.Sc. in Mechanical Engineering, or have the equivalent practical experience. Write stating age, qualifications, experience and salary required to Box 589, I.Prod.E., 36, Portman Square, London, W.1.

Works Manager. Light engineering company in the Black Country manufacturing cycles, oil burning products and toys, and also engaged on Government work, requires immediately a Works Manager. Applicants, preferably under 45 years of age—must have good knowledge of modern management methods effectively to increase production and reduce costs. Dynamic personality and ability to work as member of team are important. Salary not less than £1,200 p.a., with opportunities for advancement, and bonus according to results. Reply stating age, qualifications and experience to Box 591, I.Prod.E., 36, Portman Square, London, W.1.

Experienced Production Designer and Engineer required to develop and control well-equipped light sheet metal plant for manufacturers of Wheelbarrows, Lockers, Storage Binning, etc. (15/20 operatives). Excellent opportunity for energetic man with initiative. Expanding organisation; good remuneration. Leicester area. Box 592, I.Prod.E., 36, Portman Square, London, W.1.

Jig and Tool Designers. Crompton Parkinson, Ltd., Chelmsford, have vacancies for Senior Jig and Tool Designers. The positions are suitable for men around 35 years, experienced in the design of jigs, fixtures and press tools for medium-sized electrical plant. The positions are permanent, and a first-class superannuation scheme is in operation. Apply, giving full details of education and previous experience, to Personnel Officer, Crompton Parkinson, Ltd., Writtle Road, Chelmsford, Eessex.

Senior Jig and Tool Draughtsmen with experience of Machine Tools required. Applications with full particulars to Box 593, I.Prod.E., 36, Portman Square, London, W.1.

Junior Draughtsmen required by Coventry engineering firm. National Certificate standard. Experience of machine tool design essential. Applications to Box 594, I.Prod.E., 36, Portman Square, London, W.1.

Senior Planning Engineer required by Coventry engineering firm. Experience Process Planning and estimating machine tools essential. Applications with full particulars of age, experience and qualifications to Box 595, I.Prod.E., 36, Portman Square, London, W.1.

Senior Draughtsmen required by Coventry engineering firm. Must be experienced in design of cutting tools, special attachments for automatics and tool layouts. Applications with full particulars of age, experience and qualifications to Box 596, I.Prod.E., 36, Portman Square, London, W.1.

Production Study Engineer. Batchelors Peas Ltd., require a Production Study Engineer at their Sheffeld factory. Duties cover the measurement and application of standards for Material Control, Labour Control and Incentives, and a knowledge of Statistical Quality Control is desirable. Applicants should have, preferably, a good educational background with a degree, or show evidence of continued study after school leaving. Industrial experience must have included time study and the application of incentives, if possible in a food organisation. Age 26 to 30, starting salary £700/750, rising to £900 in this grade. Excellent opportunities for advancement to higher grades. Superannuation Scheme. Write, giving full details, education, examinations passed, industrial experience, etc., to Personnel Manager, Batchelors Peas Ltd., Sheffield.

To: THE SECRETARY,
36, PORTMAN SQUARE,
LONDON, W.1.

THE SIR ALFRED HERBERT LECTURE, 1953

Please send me ..... tickets for the above Lecture.

NAME.....

GRADE.....

ADDRESS.....

.....

.....

Assistant Works Managers required by large heavy engineering firm in Glasgow for (a) Machine Shops; (b) Fitting, Erecting, Boiler Shops. Four-figure salary. Apply stating age, full details of training, experience and previous employment. Apply Box 597, I.Prod.E., 36, Portman Square, London, W.1.

Production Development Engineer. A large Engineering group in the North-West, with world-wide connections, wish to appoint a Production-Development Engineer to review existing and new designs of their many products from the production angle, and to work closely with designers and production departments in introducing new and improved methods of production and assembly. Extensive experience in light and medium engineering, and specialised knowledge of modern techniques of production and assembly, including presswork and welding, are essential. The appointment is a senior one and will carry a salary commensurate with the responsibilities involved. A non-contributory staff pension fund is available. Applications, which will be treated in the strictest confidence, should give full details of age, education, training, posts held and salaries earned. Box 598, I.Prod.E., 36, Portman Square, London, W.1.

Production Engineers for Australia and Canada. Young Production Engineers with good technical training and machine tool and workshop experience are required by well-known manufacturers and distributors of specialised tools, inspection, and other workshop equipment, for positions of Technical Sales Representatives with own subsidiary companies in Australia and Canada. Sales experience not essential but helpful. Initial training given in London. Positions offer ample scope for initiative, and prospects. Only keen candidates with good references should apply to Box 599, I.Prod.E., 36, Portman Square, London, W.1.

Senior Jig and Tool Draughtsmen required. Sound experience of general tooling essential. Work is varied and interesting and salaries are entirely dependent upon ability with the latest A.E.S.D. rates as a minimum. Apply Geometric Designs, Ltd., 66, Victoria Street, London, S.W.1.

EDUCATIONAL APPOINTMENTS

School of Technology, Ipswich.
Applications are invited for the following full-time post: **Assistant, Grade B,** to teach Jig and Tool Design, Machines Tools and Industrial Administration to Higher National Certificate in Production Engineering standard. Knowledge of metrology, production planning or work measurement would be an additional recommendation. Salary will be in accordance with the Burnham Technical Scale, 1951, with the appropriate additions for qualifications, training and industrial experience. Forms of application and further particulars may be obtained from the Principal, The School of Technology, Tower Ramparts, Ipswich, to whom completed forms should be returned immediately.

Brighton Technical College.
Lecturer in Production Engineering. Applications are invited from suitably qualified and experienced men for the post of Lecturer in Production Engineering to undertake work up to H.N.C. standard. Salary £940 x 25—£1,040. Further particulars and application forms may be obtained from the Director of Education, 54, Old Steine, Brighton, 1, on receipt of a stamped, addressed foolscap envelope. Completed forms should be returned to the Principal, Brighton Technical College, Brighton, 7, within 14 days.

Hebrew Institute of Technology, Haifa, Israel.
Applications are invited for the post of **Professor** in the Department of Production Engineering and Industrial Management. Conditions of appointment may be obtained from the Secretary, The Technion Society of Great Britain, 13, Mansfield Street, London, W.1.

Mid-Essex Technical College and School of Art, Chelmsford.
Grade A Assistant. Required from 1st September, Grade A Assistant to teach Elementary Subjects in National Certificate and City and Guilds Courses in Engineering. Graduate or equivalent status preferred. Good industrial experience essential. Salary, Burnham Technical Report, 1951: £415 x £18—£670, with increments within scale for approved teaching, industrial experience, and war service, and additions for approved training and graduation. Application form from the Clerk to the Governors, Clerk's Office, Market Road, Chelmsford (stamped addressed foolscap envelope).

post :
hines
ional
ledge
ment
ll be
with
and
rther
chool
com-

s are
r the
rtake
,040.
ained
on, 1,
Com-
ghton

n the
strial
ained
ritain,

Art.

ade A
Certifi-
duate
rience
1951 :
e for
ervice,
Appli-
Office,
olscap.